Iron AND Steel ENGINEER

ENGINEERING SERVICE TO THE IRON AND STEEL INDUSTRY SINCE 1907

MARCH, 1955

TECHNOLOGY DEPT.

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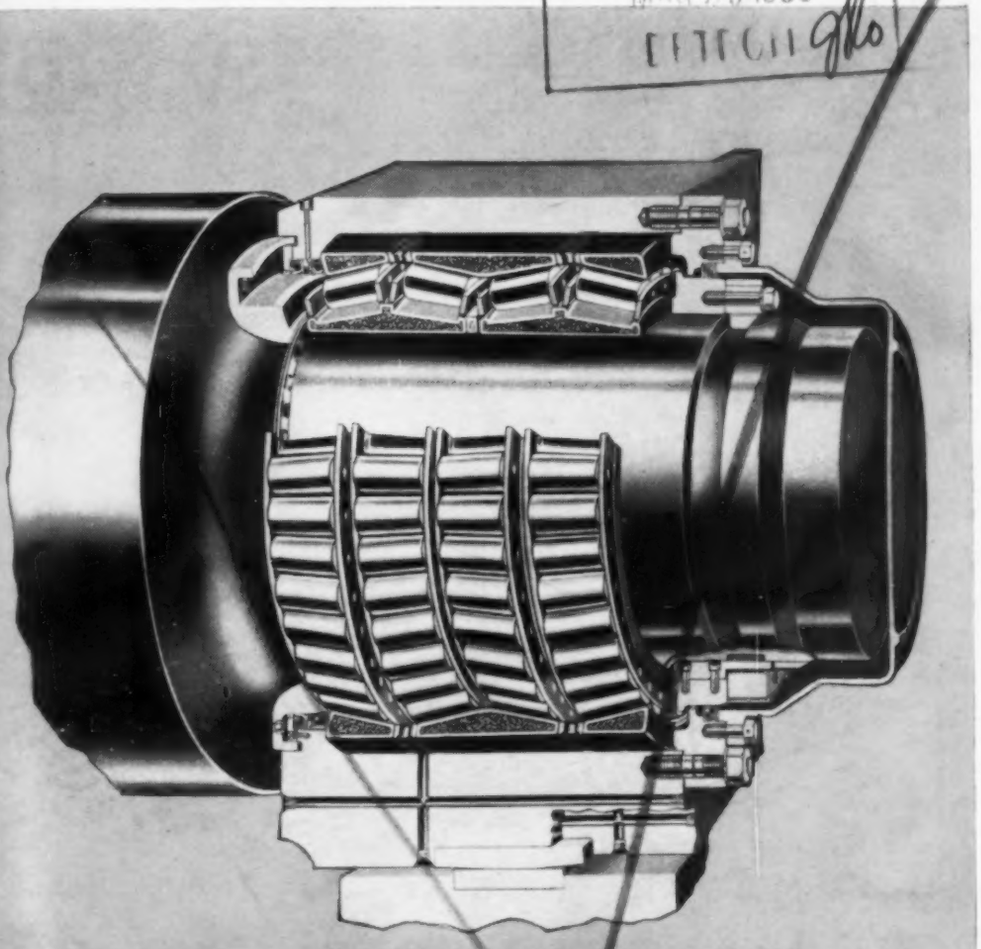
Why Allegheny Ludlum's improvement program features 130 TIMKEN® roll neck bearings



ALLEGHENY LUDLUM STEEL CORPORATION *mounts work and back up rolls on Timken tapered roller bearings to get less friction, longer life. Typical Timken roll neck bearing application is shown in cutaway.*

DOLLAR for dollar, Timken® roll neck bearings can't be beat—and mill records prove it. Actual cost figures show Timken bearing equipped mills operate at minimum bearing cost per ton of steel rolled! Allegheny Ludlum Steel Corporation has put 130 new Timken roll neck bearings on mills in the Brackenridge and Leechburg plants. It's part of their extensive program of improvements.

Timken bearings eliminate complicated lubrication systems, make roll changing easier and faster. Maintenance and repair time is cut.

The tapered design of Timken bearings lets them take both radial and thrust loads in any combination so that special thrust units are not required. And Timken bearings can take the heaviest mill loads. Line contact between rollers and races gives Timken bearings extra load-carrying capacity.

Mills accelerate more rapidly with Timken bearings because they lower starting resistance, reduce skidding and scuffing between work rolls and back up rolls. Over 50 years of bearing research and development have made Timken bearings first choice throughout industry. For more information about Timken roller bearing applications, write The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.

TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS

NOT JUST A BALL ○ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭

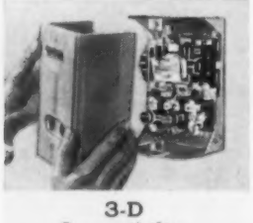
BEARING TAKES RADIAL ↓ AND THRUST →◫← LOADS OR ANY COMBINATION →✳←

WHAT'S NEW IN MOTOR CONTROL? ☆ ☆ ☆ GET IT FIRST IN CUTLER-HAMMER

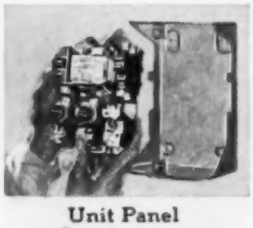
Now Cutler-Hammer ★★★ Motor Control in NEMA Size 2 for motors up to 25 HP*

It is here . . . Cutler-Hammer ★★★ Motor Control for your larger motors, NEMA Size 2 Starters with the famous three stars on the Cutler-Hammer nameplate. The three stars that stand for three entirely new standards in motor control performance and value. Star #1: Installs easier. So much easier that installation savings often exceed the cost of the control. Star #2: Works better. So much better that this control often pays for itself many times over in just the production interruptions it avoids. Star #3: Lasts longer. So much longer that this control *never* needs maintenance care or expense in 90% of its uses. If you are one of the many users who have proved these are facts, not mere claims, you will welcome the news that your larger motors can now have this same control. Order Bulletin 9586, Size 2, today from your nearby Cutler-Hammer Authorized Distributor. He is stocked and ready to serve you. CUTLER-HAMMER, Inc., 1269 St. Paul Ave., Milwaukee 1, Wisconsin.

CUTLER-HAMMER ★★★ MOTOR CONTROL C-H



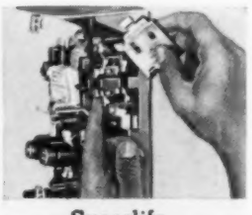
3-D Accessibility.
Removing the wrap-around cover bares the entire starter for three-directional accessibility. It is wide open at front and both sides. You can see everything and reach anything. Wiring the starter is simplified and routine inspection is made so easy and complete nothing is ever neglected.



Unit Panel Construction
The entire starter mechanism can be removed from its case by simply loosening three screws. With mechanism out of the way, mounting case, connecting conduit and pulling wires is a cinch. A great time saver. No skinned knuckles. No damaged starter mechanisms.

Full Three-Phase Protection
Only *three* overload relays can provide positive three-phase protection to stop needless motor burn-outs and production interruptions. And only Cutler-Hammer offers three overload relays in *standard* starters without the excessive costs and delays of special starter constructions.

Adjustable Sensing Coils
Only the accurate adjustment of overload protection permits motors to work harder without damage. Now more important than ever with newer type small frame motors. Only C-H offers adjustable load sensing coils . . . for 3% loading accuracy instead of the 10% to 12% in all other controls.

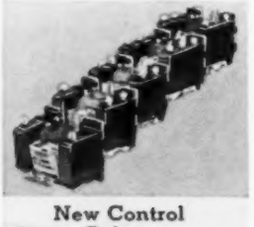


Superlife Vertical Contacts
Now the famous C-H dust-safe vertical contacts have been doubly improved. New light-weight design cuts bounce to reduce arcing. Also, arcing is now pressure-quenched. Contact maintenance care and costs are ended for all time in all normal motor control uses.

For Control Panel Designers

The new Cutler-Hammer ★★★ Motor Control offers an array of spectacular new features to provide many exclusive advantages in circuit planning, compact panel design, better motor protection and better control performance. Be sure you have complete design data on this advanced equipment. Write or wire today.

New Control Components
All parts of the new C-H ★★★ Starters in NEMA 0, 1 and 2 Sizes are available as components; also complete starters on convenient unit panels. Electrical interlocks are available to provide additional control circuits when desired.



New Control Relays
Finest of control relays. 10 and 15 Amp. 2-3-4-5-6 poles. All contacts instantly convertible from NO to NC or vice versa. NO or NC status seen at a glance without removing cover. New armored magnet coils color coded for voltage and frequency.

New SD & HD Pushbuttons
New standard duty pushbutton station with pilot light offers many exclusive features, typical of complete C-H line. Watch soon for announcement of the revolutionary new line of C-H heavy-duty oil-tight one-hole mounting pushbuttons.

IRON AND STEEL ENGINEER; published monthly by Association of Iron and Steel Engineers, 1010 Empire Bldg., Pittsburgh, Pa. Second class mail privileges authorized at Pittsburgh, Pennsylvania, January 25, 1924.

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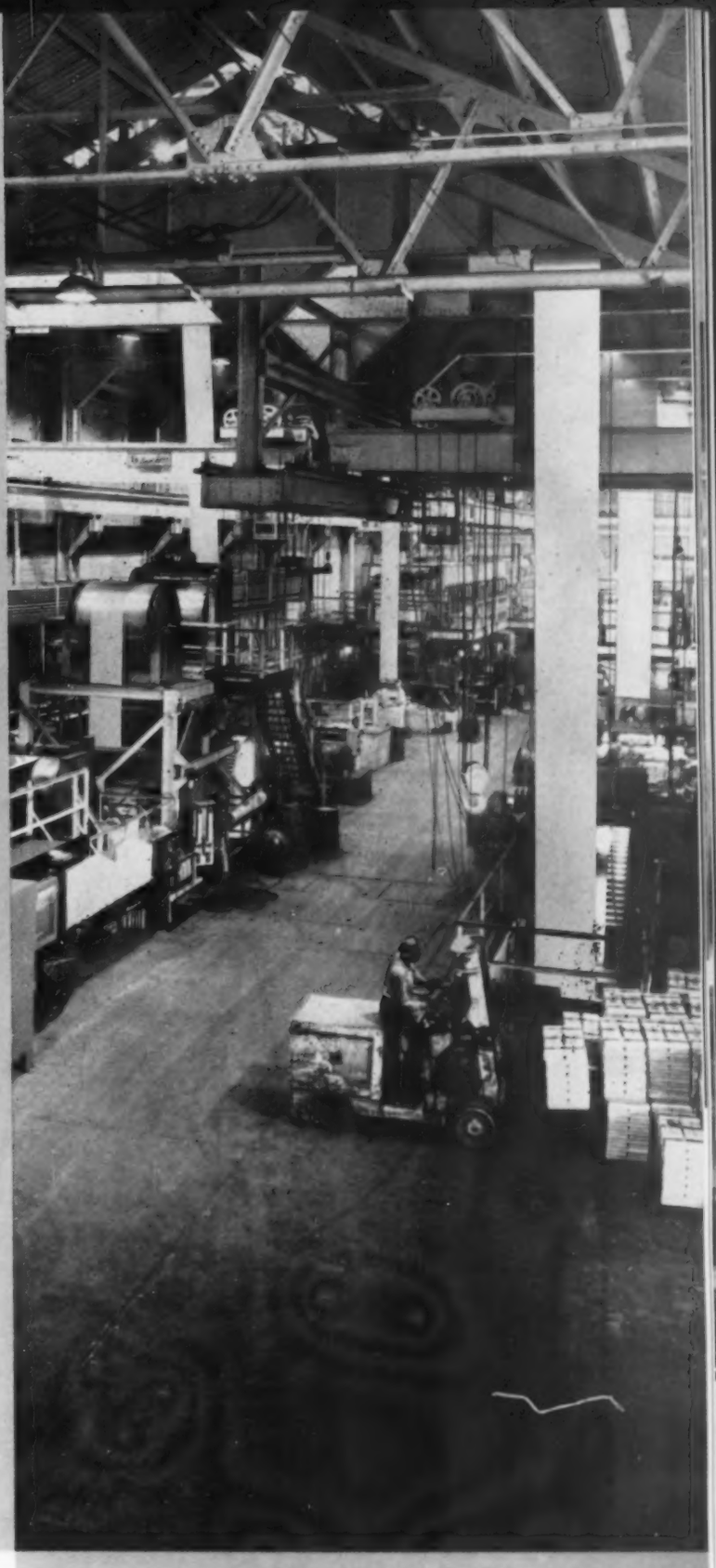
CONTINUOUS GALVANIZING LINES BUILT BY AETNA



● **The 25th Aetna-built Continuous Galvanizing** Line could be yours. If you are considering a Continuous Galvanizing Line, you probably have ideas about the most practical process for your production. The lines offered by Aetna-Standard include all of the different processes and types in use today. This ability to combine specialized knowledge of Continuous Galvanizing with your own specific ideas is a principal reason for Aetna's building more lines than all other manufacturers. Add the most important requirement of all—performance of the equipment, plus integrity and ability to work with people, and you have some of the reasons why more companies select Aetna-Standard than any other manufacturer to build their Continuous Galvanizing Lines.

Will the 25th be yours?

THE AETNA-STANDARD ENGINEERING COMPANY · PITTSBURGH, PA.

Aetna-Standard

PLANTS IN WARREN, OHIO · ELLWOOD CITY, PENNSYLVANIA

GOOD EQUIPMENT BRINGS DOWN PRODUCTION COSTS

SUBSIDIARY and ASSOCIATED COMPANIES

Head Wrightson Machine Company, Ltd., Middlesbrough, England — Great Britain, Finland, Sweden, Norway, Denmark, Union of South Africa, Northern and Southern Rhodesia.

Aetna-Standard Engineering Company, Ltd., Toronto, Ontario, Canada.

M. Castellvi, Inc., New York, N. Y. — Mexico, Central and South America.

Societe de Constructions de Montbard, Paris, France — France, Belgium, Holland, Luxembourg, Switzerland.

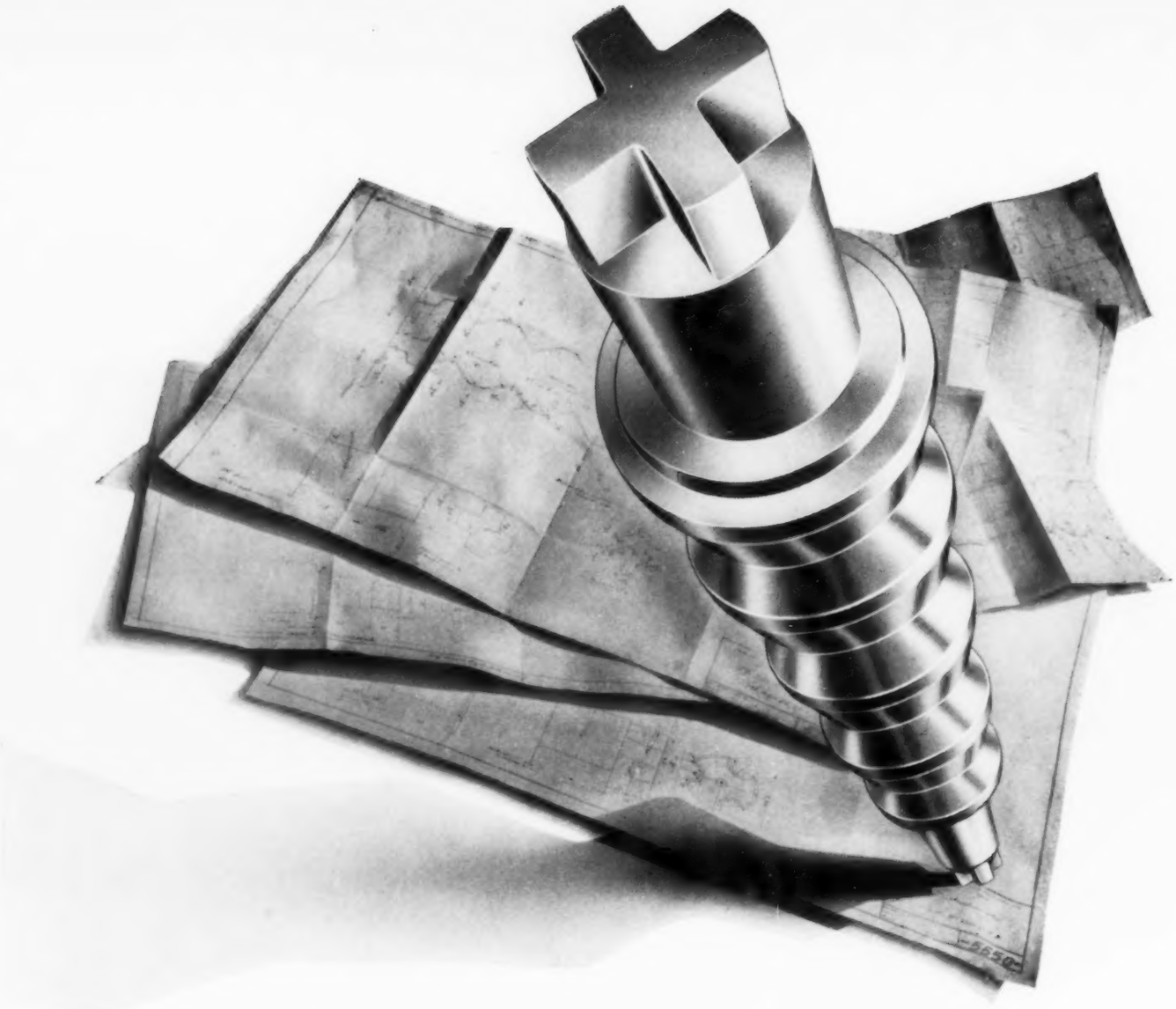
Demag Aktiengesellschaft, Duisburg, Germany — Germany, Austria, Yugoslavia, Greece, Turkey, Egypt.

Compagnia Italiana Forme Acciaio, Milano, Italy — Italy.

Aetna-Japan Company, Ltd., Tokyo, Japan — Japan.

Hale & Kullgren, Inc., Akron, Ohio — Representative for the Rubber Industry.

Designers and Builders to the Ferrous, Non-Ferrous, Leather, Rubber, and Plastic Industries



Planned for Precision

From the drawing stage of a roll to its final inspection, National always keeps in mind the importance of precision . . . and that is reflected in every roll that National produces. We know that you must have precision in rolls to give your customers precision in rolled metals. So for precision rolls to your specifications, call on National.

THE NATIONAL ROLL & FOUNDRY CO.

Avonmore, Pennsylvania

Specialists in Iron, Alloy Iron and Steel Rolls and Castings, Steel Armor Castings

Two 60-Ton Mill Type Bedford Cranes work independently or in tandem

Pictured in the foreground above is a 60-ton, 120′ span Bedford Crane with 10-ton auxiliary. The crane in the background on the same runway is an identical twin.

Installed recently in a large eastern steel fabricating plant, both cranes were built to AISE specifications. All controls are of the open panel type mounted in a walk-in steel control house.

Used for handling long span bridge members, the cranes may be operated independently or in tandem to handle loads ranging up to 125 tons.

Experienced steel men know that Bedford Cranes—backed by more than 53 years of crane building and utilization know-how—will deliver consistent top notch performance through the years. They know every advanced design feature of a Bedford Crane will pay off in a safer, smoother, more dependable operation. They know that every Bedford Crane is custom engineered and precision built for its specific application.

You are invited to consult a Bedford Engineer on your next crane problem . . . with all the facts on the table, we believe you too will make your next crane a Bedford . . . available in all types and sizes, from 5 tons to 350 tons and up.

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Phone ATlantic 1-0136

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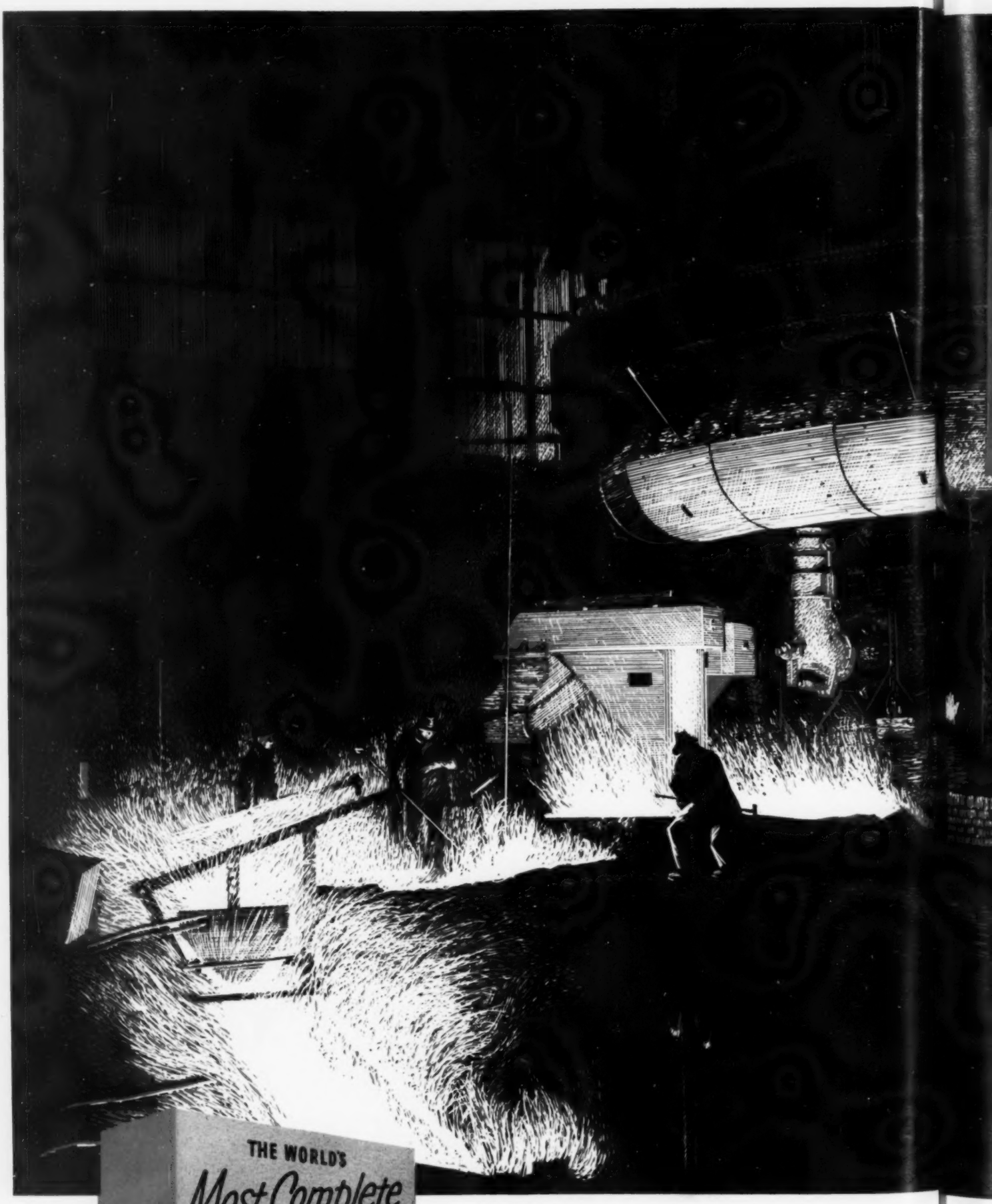
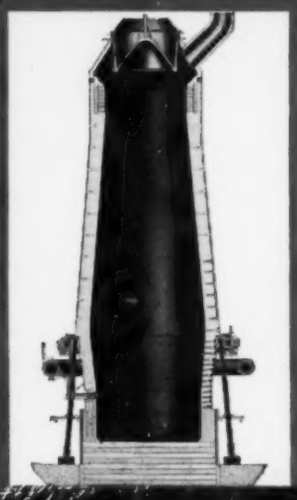


HARBISON-WALKER
AND SUBSIDIARIES

Harbison-Walker



BLAST FURNACE REFRACTORIES

specialized types
research-developed and service-proved
for every furnace requirement

The major portion of iron made on this continent is cast from furnaces lined with Harbison-Walker refractories

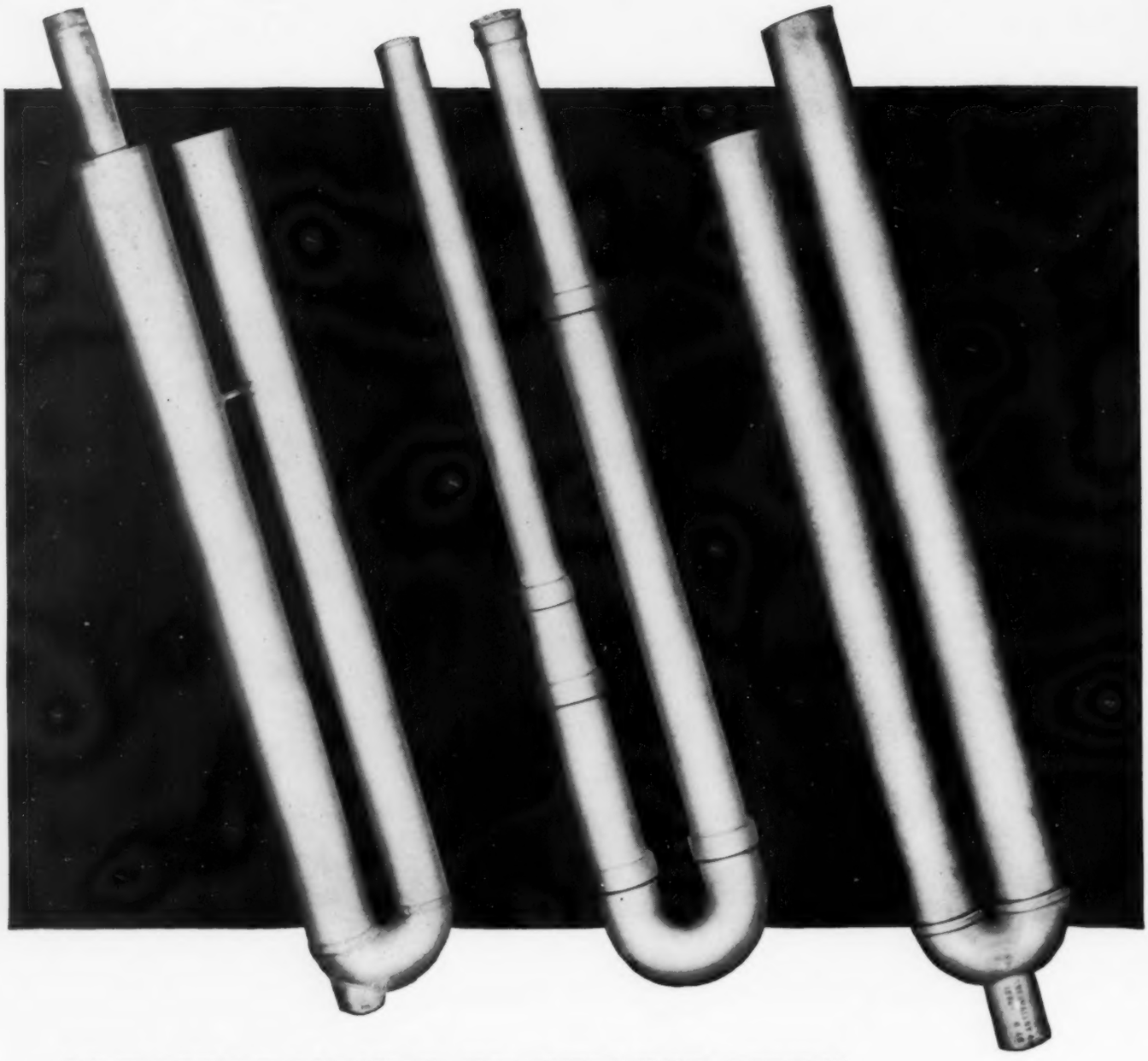
The railroads were still pushing back the frontiers of America when Harbison-Walker manufactured its first blast furnace lining. During the years which have followed, the company has made the majority of all the blast furnace refractories used in the United States. Today there are more Harbison-Walker linings in service than all others.

The high standing of Harbison-Walker blast furnace refractories has been maintained through continuous product research and the continuous development of more precise methods of manufacture. Progress in blast furnace operation has demanded superior performance from refractories and Harbison-Walker refractories have kept abreast.

You are invited to consult Harbison-Walker regarding any of your refractories problems. The value of the company's recommendations is based upon its wide experience, its technical staff and its service records.

REFRACTORIES COMPANY

World's Largest Producer of Refractories • *General Offices: Pittsburgh 22, Pennsylvania*



GET MORE HOURS OF SERVICE FROM

Thermalloy* radiant tubes

Make Electro-Alloys your source if you want radiant tube assemblies that will give more life and reduce maintenance costs.

All components are produced in suitable analyses under close metallurgical supervision, and with X-ray control. The straight tube sections are centrifugally cast in such a way that wall thickness is uniform throughout; i. e., inside diameter and outside diameter are concentric, and thickness is the same the full length of the tube. All finished assemblies are pressure-tested before shipment to insure freedom from leakage. As a result, you are assured of radiant tube assemblies that last longer without cracking, warping or sagging.

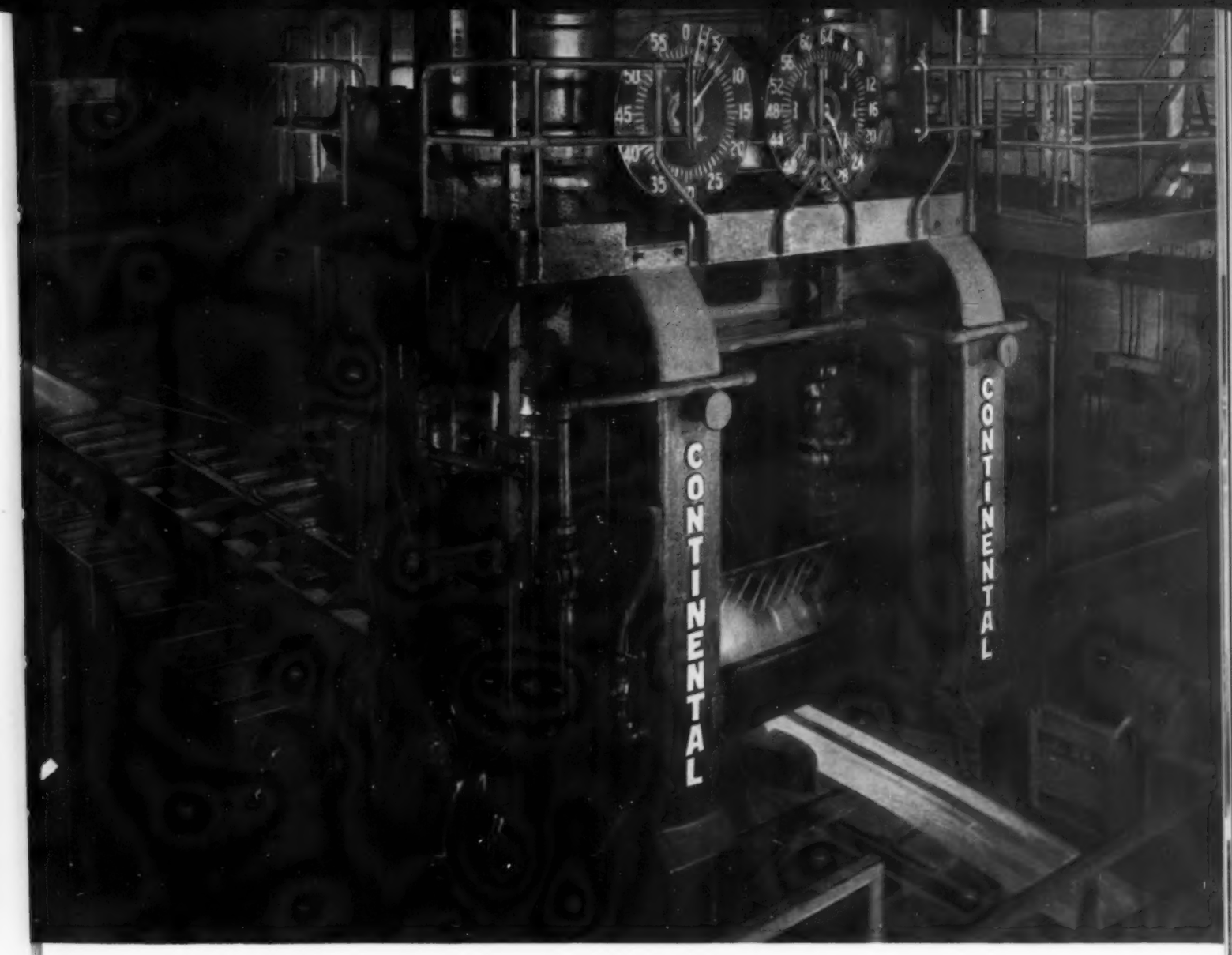
Whatever your needs in radiant tube assemblies or other heat-treating equipment—you'll get more operating economy from high heat-resistant Thermalloy castings. Let us know your requirements. Call your nearest Electro-Alloys engineer or write Electro-Alloys Division, 6004 Taylor Street, Elyria, Ohio.

AMERICAN Brake Shoe COMPANY

ELECTRO-ALLOYS DIVISION

ELYRIA, OHIO

*Reg. U. S. Pat. Off



Ruggedly designed for multiple sections and ease of changing high-collared rolls

Blooming Mill rolls blanks for structurals and rails

At Sault Ste. Marie, Ontario, the Algoma Steel Corporation operates this CONTINENTAL intermediate two-high reversing mill that produces the wide range of slabs and blooms necessary for finishing rails and structurals.

CONTINENTAL designed and manufactured the complete mill including rolls and auxiliary equipment. Because rugged design brings continuity of operation which leads to greater production, CONTINENTAL has emphasized rigidity throughout. The heavy cross-section housing of cast steel is of the CLOSED-TOP DESIGN. The wide windows receive 52-inch, high-collared rolls. A motor-driven CONTINENTAL Roll-Changing Rig is provided to minimize delay in the many necessary roll changes required to produce the wide range of products.

Automatic screw downs of extremely accurate settings are optional. They predetermine the rolling schedule. This allows the operators to concentrate all their attention on mill reversals and manipulations. It speeds up production.

As you probably know, CONTINENTAL produces complete rolling mill installations—from preliminary engineering to satisfactory operation. Also builds special steel plant and cold processing machinery, iron and steel rolls, steel castings and weldments as well as boiler cleaning and control equipment. We'll be glad to discuss your requirements.

CONTINENTAL

Engineering and Sales Office, 220 Grant St., Pittsburgh 19, Pa.
***Plants at* East Chicago, Ind. • Wheeling, W. Va. • Pittsburgh, Pa.**
***Copes-Vulcan Division*, Erie, Pa.**

CONTINENTAL
Foundry & Machine Company

Centerless turning or peeling for bars and tubes

Now you can equip for centerless turning or peeling of bars and tubes in a full size range from 1″ to 10″ with constant end-to-end feed and delivery.

This Model RFRG Centerless Turner will deliver high production with superior finish . . . close tolerance turning . . . or, rough peeling. Workpiece size and throughput speeds are limited only by the capacity of the cutting tools. Either one or two cutter heads may be used with one to ten tools of either carbide or high speed type for maximum cutter flexibility.

New direct-drive roll feed with patented universal centering device insures continuous, positive feed and automatic centering of work. Separate variable drives for feed and cutterhead give precise ratio between bar feed and cutter speeds. Automatic input and output grip carriages permit constant feed and delivery without shut-down. Fully automatic push button control from central station.

If your operations call for fast, accurate centerless turning or peeling of ferrous or nonferrous bars or tubes, call in your Continental-Medart representative.

Write for illustrated literature.

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CONTINENTAL
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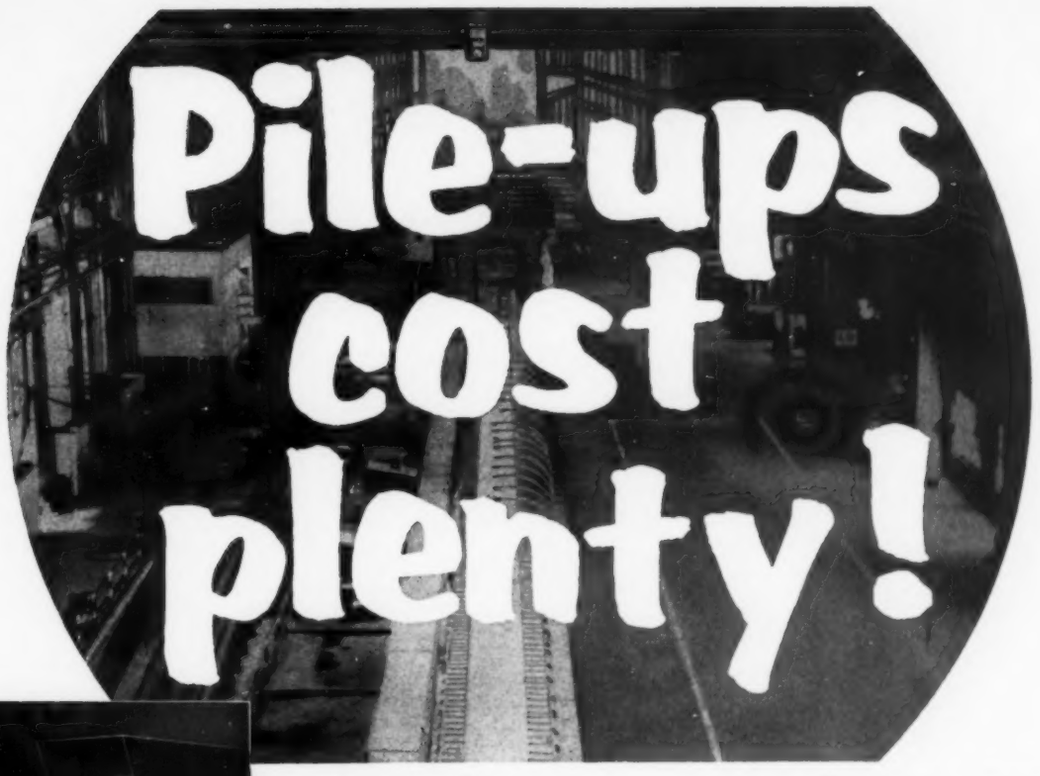

. . . So they prevent them at Gary with RCA Industrial TV

One pile-up at United States Steel Corporation's Gary Sheet and Tin Mill could mean as much as 15 minutes lost production time, or approximately 120 tons of steel! So, at their 80-inch strip mill they installed RCA Industrial TV. This mill holds the world's record for production of hot strip.

A TV screen on the control pulpit (see photo) permits the operator to maintain control of the movement of the hot strip. Television affords the opportunity to keep constant watch and to spot threats of pile-ups before damage occurs. In this way control of strip shape is improved, costly delays are minimized . . . hundreds of tons of steel are saved. The RCA Industrial TV system has been in continuous operation for over a year.

Have you problems of observing operations where it's too hot . . . too dangerous . . . too inaccessible for men to go? RCA Industrial TV permits continuous close supervision of rolling mill operations, furnace combustion, tapping, pouring, and similar hazardous procedures.

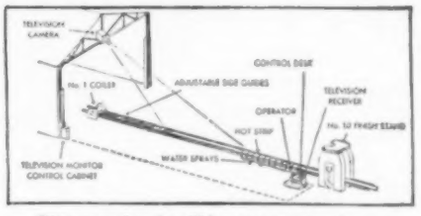

Diagram showing TV camera mounting

And RCA's practical Service Plan provides for service by experienced factory-trained RCA engineers. Let us make a survey of your Industrial TV requirements without obligation. Use coupon below for literature.

RCA CAMERA . . . compact, rugged, built to give unfailing service under rough operating conditions. Uses the sensitive RCA-developed time-proven Vidicon Tube.

RCA MONITOR . . . shows stable, high-definition picture, assures accurate reproduction of fine details. For convenience and ease of operation all controls for camera and TV are located on control monitor.

ACCESSORIES . . . include water-cooled camera lens, explosion-proof housing, panel-mounting monitor, camera switcher, industrialized auxiliary viewer, remote iris, remote focus, pan and tilt assembly, and other field-proven equipment.

New low prices now in effect

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Please send me new booklet, "Supervision by Television."

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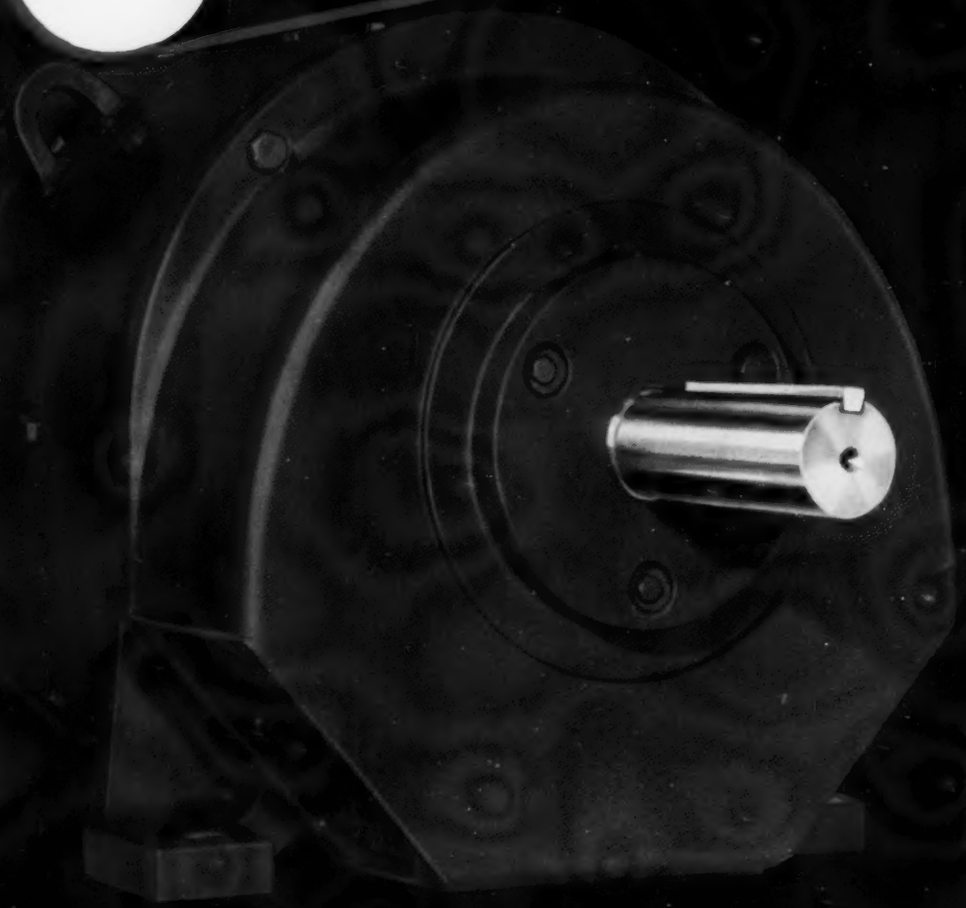
CITY _____ ZONE _____ STATE _____

THE NEW RELIANCE

Super 'T' LINE

D-C. MOTOR

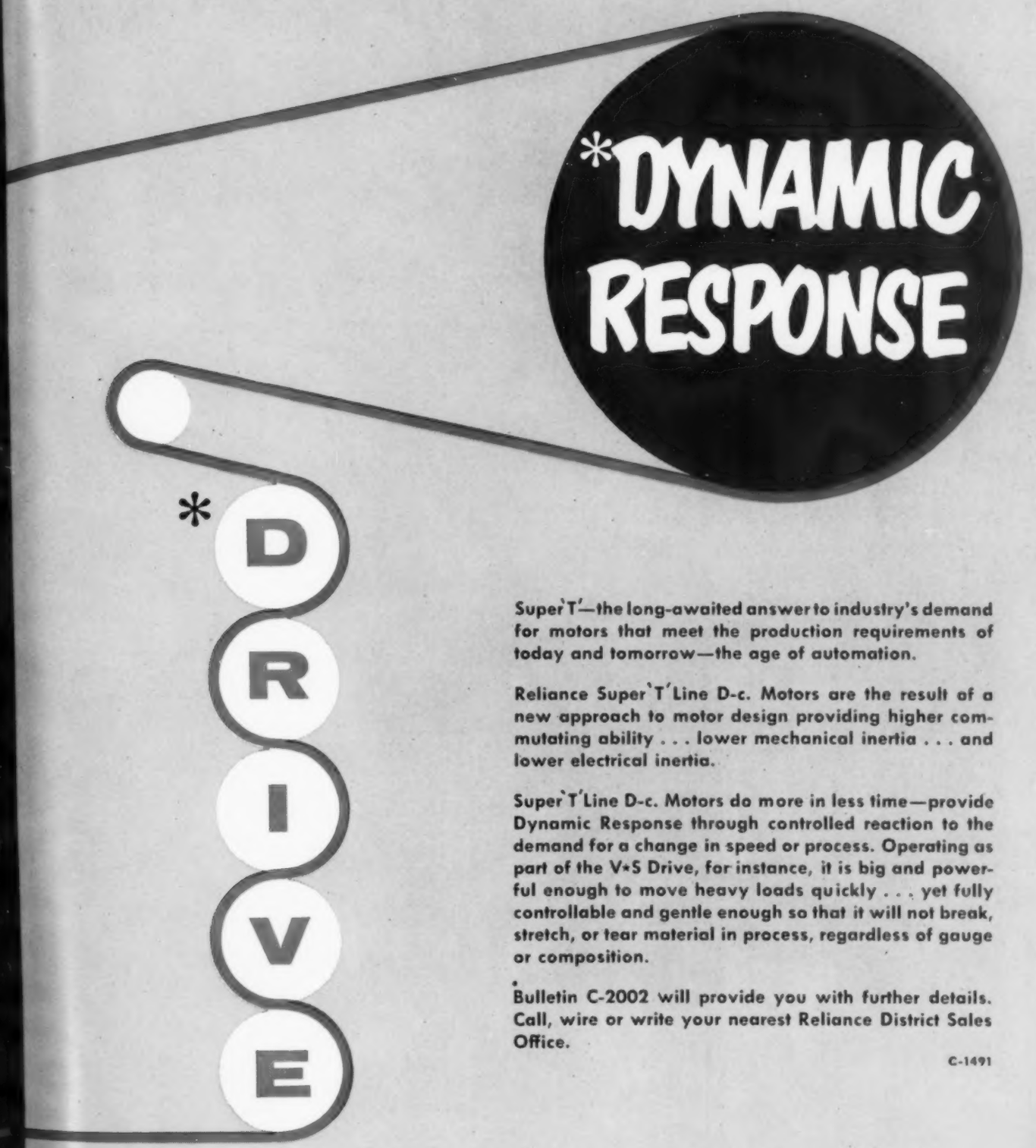


RELIANCE ELECTRIC AND ENGINEERING CO.

1084 IVANHOE ROAD • CLEVELAND 10, OHIO

Canadian Division: Welland, Ontario

The most revolutionary new motor development in 40 years!



Super'T'—the long-awaited answer to industry's demand for motors that meet the production requirements of today and tomorrow—the age of automation.

Reliance Super'T'Line D-c. Motors are the result of a new approach to motor design providing higher commutating ability . . . lower mechanical inertia . . . and lower electrical inertia.

Super'T'Line D-c. Motors do more in less time—provide Dynamic Response through controlled reaction to the demand for a change in speed or process. Operating as part of the V*S Drive, for instance, it is big and powerful enough to move heavy loads quickly . . . yet fully controllable and gentle enough so that it will not break, stretch, or tear material in process, regardless of gauge or composition.

Bulletin C-2002 will provide you with further details. Call, wire or write your nearest Reliance District Sales Office.

C-1491

Another of the Reliance Tools of Automation

Philadelphia Ore Dock
–lubricated with

Gulf Sales Engineer A. L. Sears looks over a portion of the 100 tons of equipment that make up the clamshell bucket turntable and man trolley drive. Gulf E.P. Lubricants and Gulf Precision Grease protect the gear drives and bearings.

A view from the weigh hopper down the conveyors to the unloading towers. The cargo of a waiting ore boat is being speedily unloaded.

Facilities

GULF QUALITY OILS *and* GREASES—

speed ore from new mines to mills

THE PENNSYLVANIA RAILROAD'S new ore dock, on the Delaware River near Philadelphia, can unload at one time any two of the largest ships carrying ore from the new mines in South America, Africa, and Labrador. After unloading, the ore is conveyed up to the weigh hopper and then is loaded into rail cars for rapid shipment to various steel mills.

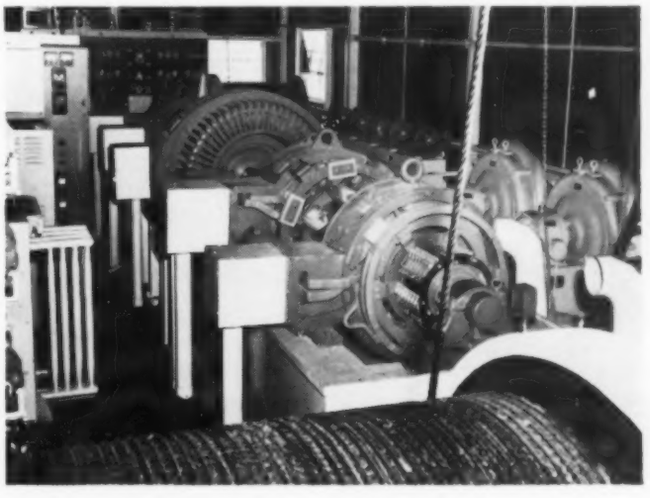
Gulf quality oils and greases provide the vital lubrication so necessary for smooth, continuous operation of this important facility.

Gulf E.P. Lubricants protect the drives in the unloading tower, conveyor belts, and bucket turntable. The bearings of all the motor-generator sets in the unloading tower are lubricated by Gulf Harmony Oil; the boom hoist and clamshell bucket cables by Gulf Lubcote; the belt drum and drum shaft bearings by Gulf Precision Grease; and Gulf High Pressure Grease keeps the 5000 conveyor belt idler bearings operating smoothly.

These are but a few of the hundreds of petroleum products Gulf makes available to fit your every need. Each fuel and lubricant has been developed by Gulf technologists to insure better performance of equipment and lower operating costs.

Make sure you are getting the advantages of all recent developments in petroleum science. Contact your nearest Gulf office today and have a Sales Engineer call.

The control room of the unloading tower with the boom hoist cable in the foreground. Gulf Harmony Oil and Gulf Lubcote protect the motor-generator bearings and boom hoist lines respectively.



GULF OIL CORPORATION • GULF REFINING COMPANY
1822 GULF BUILDING, PITTSBURGH 30, PA.

GULF

THE FINEST PETROLEUM PRODUCTS FOR YOUR EVERY NEED

"Dated" instruments drain away dollars

Instruments can become outmoded . . . just like automobiles and ideas. Progressive instrument development is constantly making many older designs obsolete . . . and such obsolescence can be a steady drain on profits.

Modern instruments save money

Honeywell engineers are proving this fact every day—in a growing number of plants, on all types of processes. Where out-of-date controls have been replaced by modern Honeywell instrumentation, economy-minded engineers and management men have really opened their eyes. And with good reason, for—

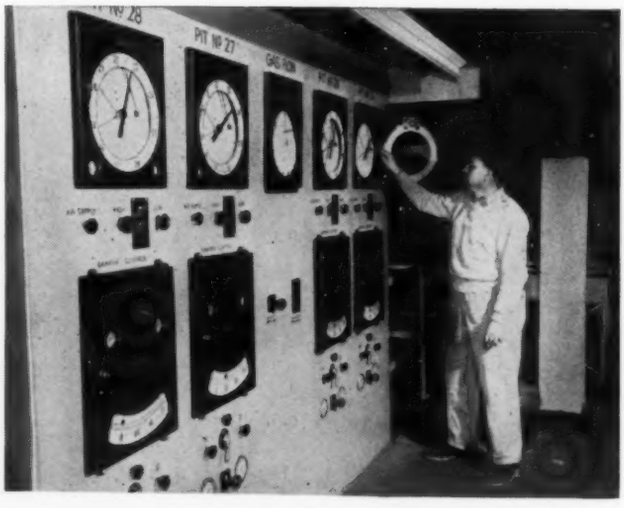
- Modern Honeywell instrumentation saves labor. Centralized control, automatic time-cycle systems, and other recent control concepts save countless wasted steps . . . reduce routine man-hour expenditures.
- Modern Honeywell instrumentation cuts maintenance costs. It affords longer, uninterrupted operation . . . is designed for easy service . . . requires minimum attention.
- Modern Honeywell instrumentation reduces rejects. It maintains the tighter process tolerances demanded by today's more exacting specifications.
- Modern Honeywell instrumentation improves product quality. Precision measurement and control remove any chance of error or guesswork in critical processes.
- Modern Honeywell instrumentation makes cost accounting more accurate than ever before. Everything is a matter of record.

An investment that really pays off

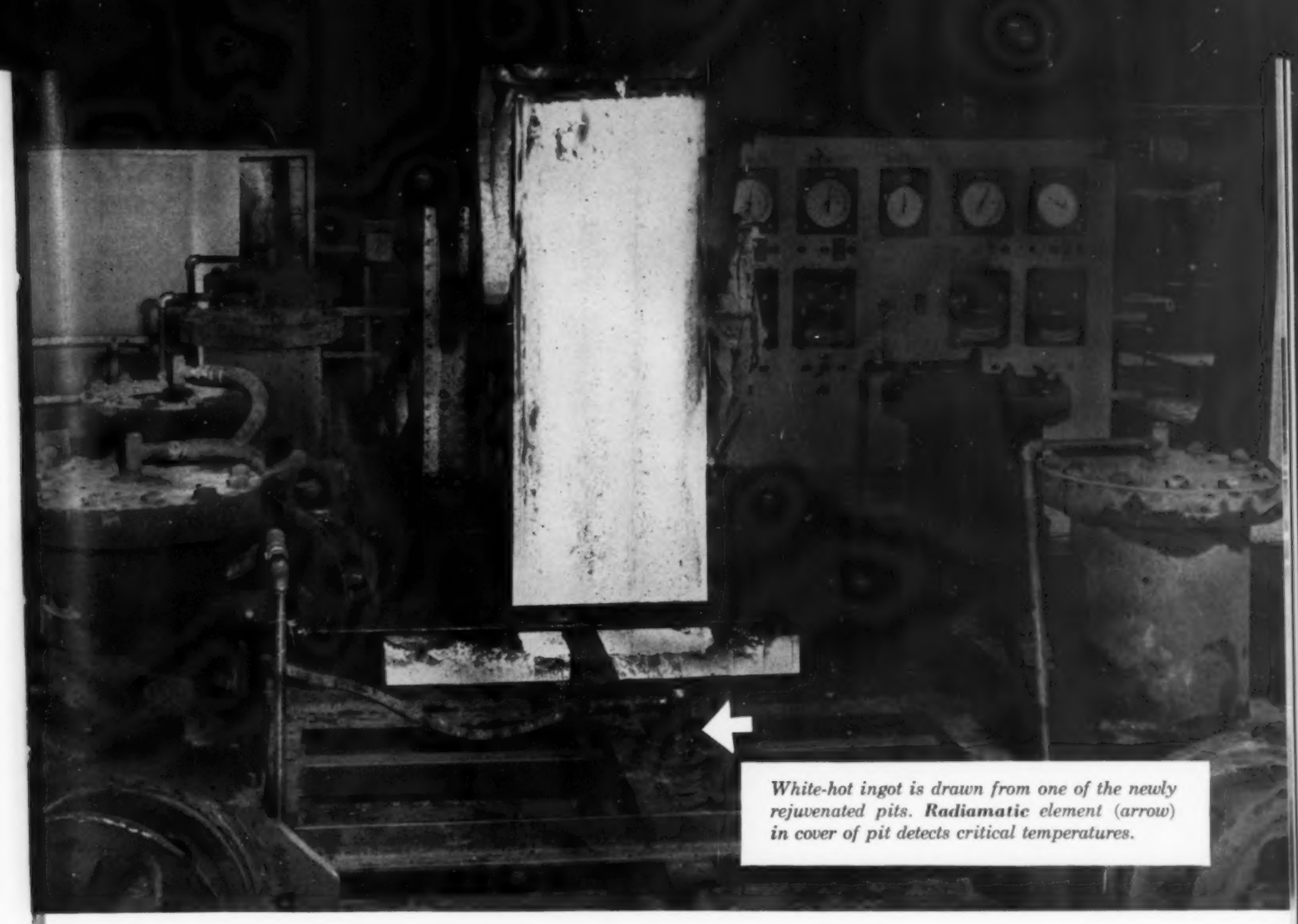
Just being "instrumented" is not enough. You can get more out of your instrument dollar, from both a product and service stand point, with Honeywell instrumentation...the ultimate in engineering and design . . . insurance for your equipment investment.

Replacing with Honeywell is one of the best ways to invest your modernization appropriation. A Honeywell application engineer will gladly survey your present plant instrumentation . . . give you a practical recommendation that will make dollars and sense. Give him a call . . . he's as near as your phone.

C F & I reaps big savings from pit modernization



A focal point of modernization is this Brown instrument control panel for four regenerative soaking pits. Savings accomplished on this installation have led CF&I to decide on similar modernization for all pits in the mill.



White-hot ingot is drawn from one of the newly rejuvenated pits. ***Radiamatic*** *element (arrow) in cover of pit detects critical temperatures.*

using Brown® instruments

FIFTY-YEAR-OLD soaking pits at Colorado Fuel & Iron Corp. have been brought back to a new peak of efficiency, by means of a thorough modernization program which makes full use of up-to-date Brown instrumentation.

Four of the 28 pits for the 40-inch mill were tackled first, to see how the program would work out. Height and width were modified to provide better combustion, and new covers installed to give better seals. Most significant improvement, however, was the installation of complete, centralized instrumentation . . . consisting of *Radiamatic*® radiation detectors for pit temperatures, *ElectroniK* controllers for regulating fuel input, an automatic reversal system, Brown Furnace Pressure Controllers actuating new damper systems, and Brown Flow Meter for totalizing fuel consumption.

After almost a year's operation, the dollars-and-cents results have exceeded all expectations.

- Yield has increased by $14,000 per year, due largely to improved uniformity of heating and better surface conditions.
- Crane time has dropped 15 to 25 per cent because ingots no longer need to be charged bottom side up for correct heating.
- Fuel rate has dropped about 25 per cent as a result of improved heating efficiency.
- Pit life increase is estimated at 50 per cent . . . refractory savings amount to 6 cents per ton.
- Daily bottom making has been slashed from 1½ hours to 25 minutes for the row.

Your nearby Honeywell sales engineer will be glad to discuss how modern instrumentation can become an important . . . and fruitful . . . part of your own modernization program. Call him today . . . he's as near as your phone.

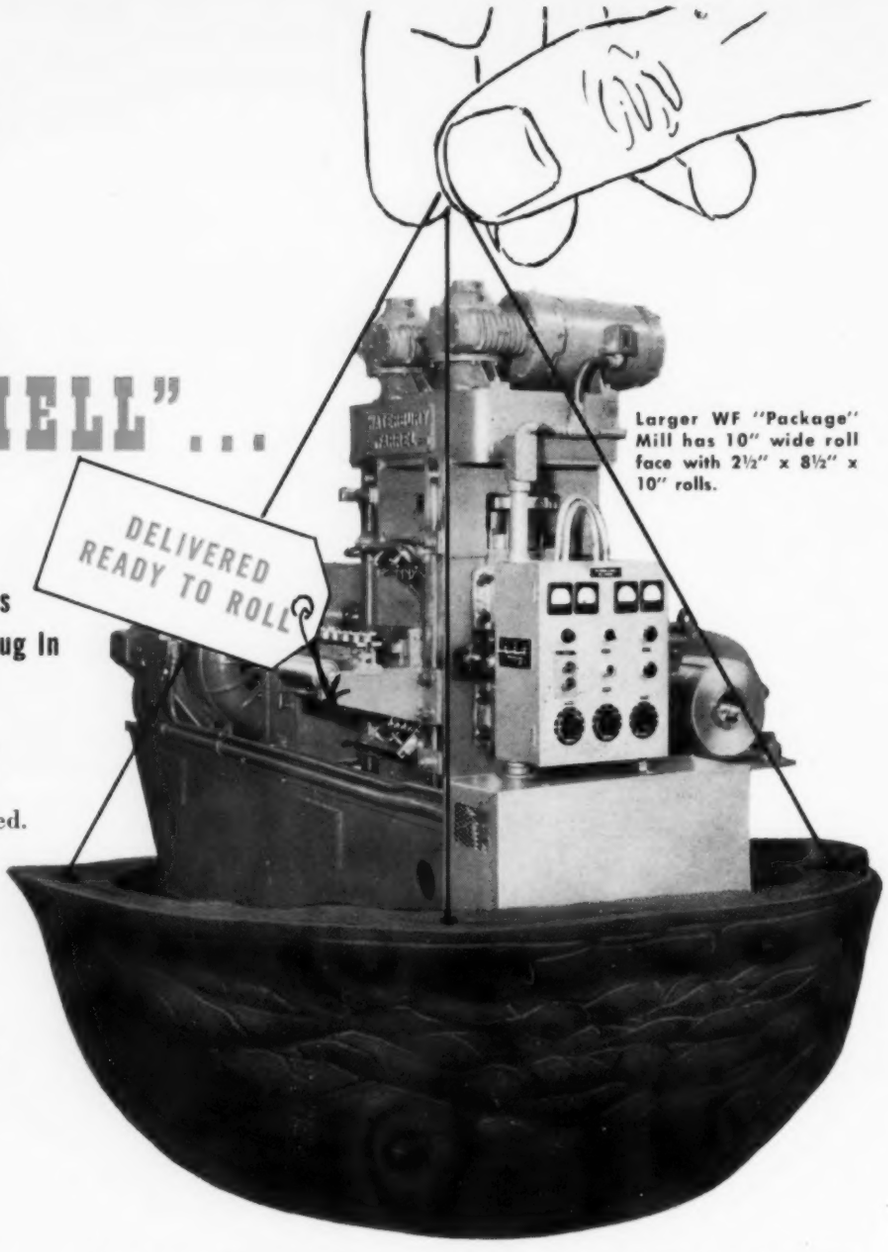
MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.

● **REFERENCE DATA: Write for the new booklet "Modernization", and for Catalog 1531, "*ElectroniK* Controllers."**

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls

Waterbury Farrel's New, ONE-PIECE

STRIP MILL "IN-A-NUTSHELL"...

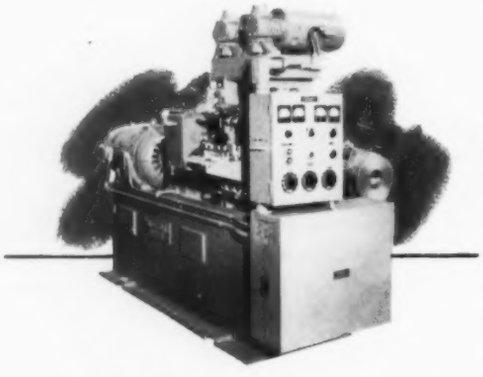


Larger WF "Package" Mill has 10" wide roll face with 2½" x 8½" x 10" rolls.

WF's 4-High "Package" Rolling Mills Are Compact, Low Cost, Ready To Plug In

You can start precision-rolling ferrous or non-ferrous strip as soon as you plug in the electrical connection.

This mill is completely self-contained. Drive, gear case, controls, lubrication system, winder and winder drive are assembled with the mill, itself, into a single, compact unit. When necessary, it can easily be moved in one piece to a new location.



Smaller WF "Package" Mill has 6" wide. roll face with 1⅝" x 6½" x 6" rolls.

Some Construction Features: **Mill frame of unit welded plate steel gives maximum strength and rigidity . . . assures greater accuracy and lasting alignment . . . alloy steel work rolls mounted in needle bearings . . . alloy steel back-up rolls drilled for water cooling, mounted in double row Timken bearings with tapered sleeve . . . independent power screwdowns . . . long and short roll necks and staggered couplings permit heavier construction for maximum torque capacities . . . lucite cover on welded steel gear case facilitates inspection . . . variable speed tension control drive, using AC power, cuts control cost and permits compact panel.**

Contact Waterbury Farrel for complete details. No obligation.

WATERBURY FARREL FOUNDRY & MACHINE CO. • WATERBURY, CONN.

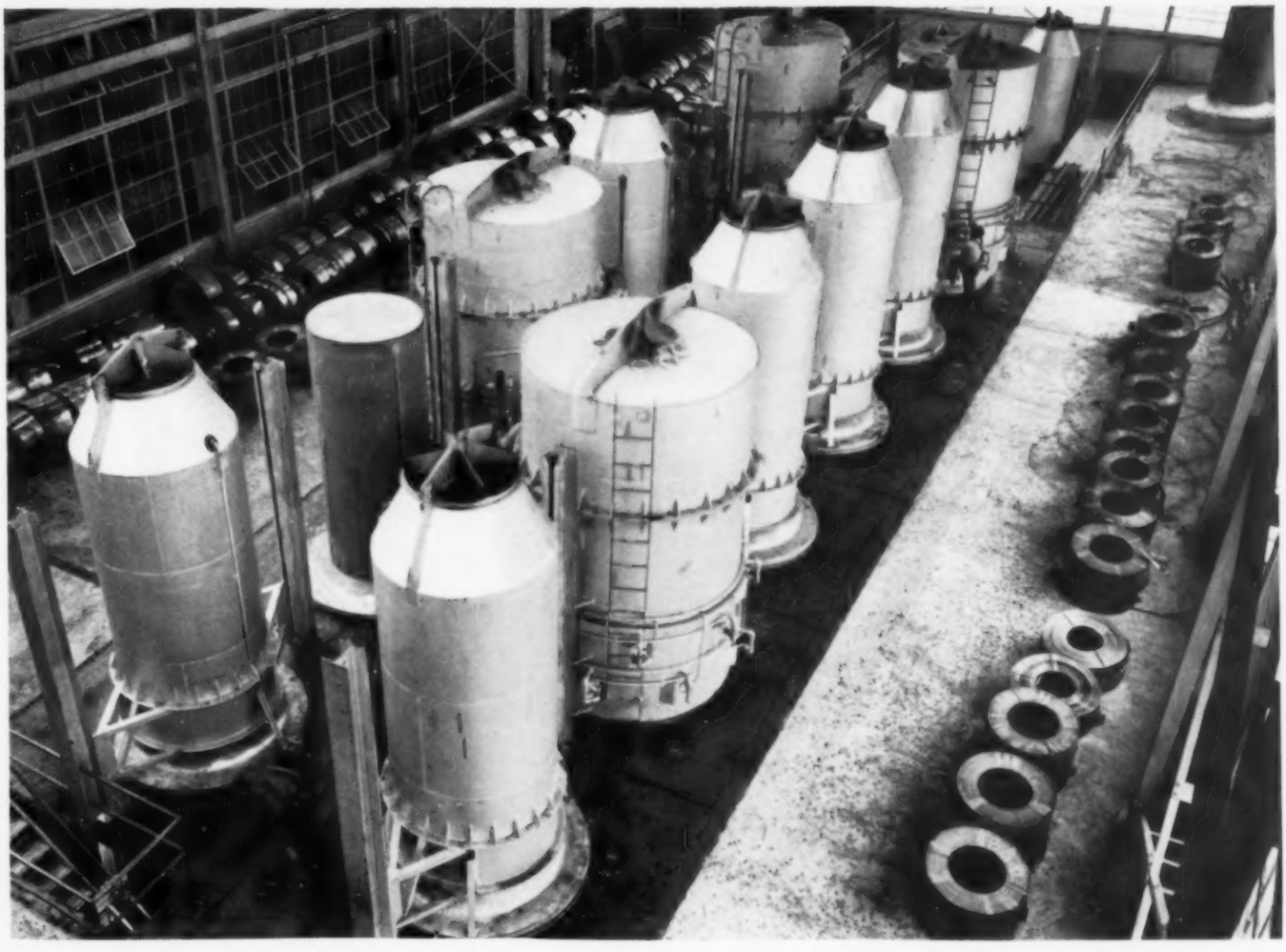
Offices: **Chicago, Cleveland and Millburn, N. J.**

A FEW OF THE MANY TYPES OF METAL WORKING MACHINERY MADE BY WATERBURY FARREL

MILL MACHINERY—Rolling Mills: Strip, Rod, Wire Flattening, (For Ferrous and Non Ferrous Metals) • Also Slitters • Straighteners • Cut-off Saws • Coilers • Winders, etc. *WIRE MILL EQUIPMENT*—Continuous Wire Drawing Machines (Upright Cone and Tandem) • Wire Flattening Mills • Chain Draw Benches • Pointers Swagers • Bull Blocks • String-up Machines • Spoolers, etc. *COLD PROCESS BOLT & NUT MACHINERY*—Headers (all types) • Rivet Machinery • Trimmers • Thread Rolling Machines • Slotters • Nut Formers and Tappers, etc. *POWER PRESSES*—Crank, Cam and Toggle; also Rack and Pinion Presses • Eyelet Machines Multiple Plunger Presses • Horizontal and Hydraulic Presses, etc.

WATERBURY FARREL FOUNDED 1851

WF-17



"Westinghouse furnaces stepped up our production"

. . . says Thompson Wire Co.

Thompson Wire Co. is now using four *gas-fired* Westinghouse cylindrical bell-type furnaces, 12 bases, 12 inner hoods, and 8 air-cooling hoods. A fan, mounted on top of each cooling hood, draws air between the work hood and cooling hood, exhausting heated air to the top, thus accelerating cooling of the charge.

This entire new operation has given Thompson Wire Co., greater load per heat, faster cooling, less maintenance costs and increased production.

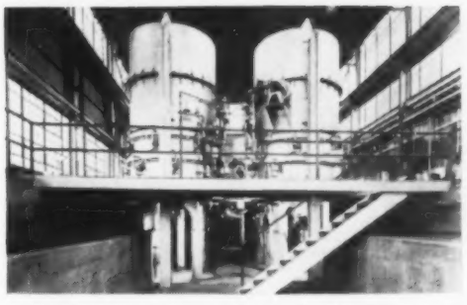
Investigate Westinghouse heat-treating furnaces with an eye toward cutting costs and increasing capacity.

For more information regarding Westinghouse heat-treating furnaces, write or call your nearby Westinghouse office. J-10439

YOU CAN BE SURE...IF IT'S

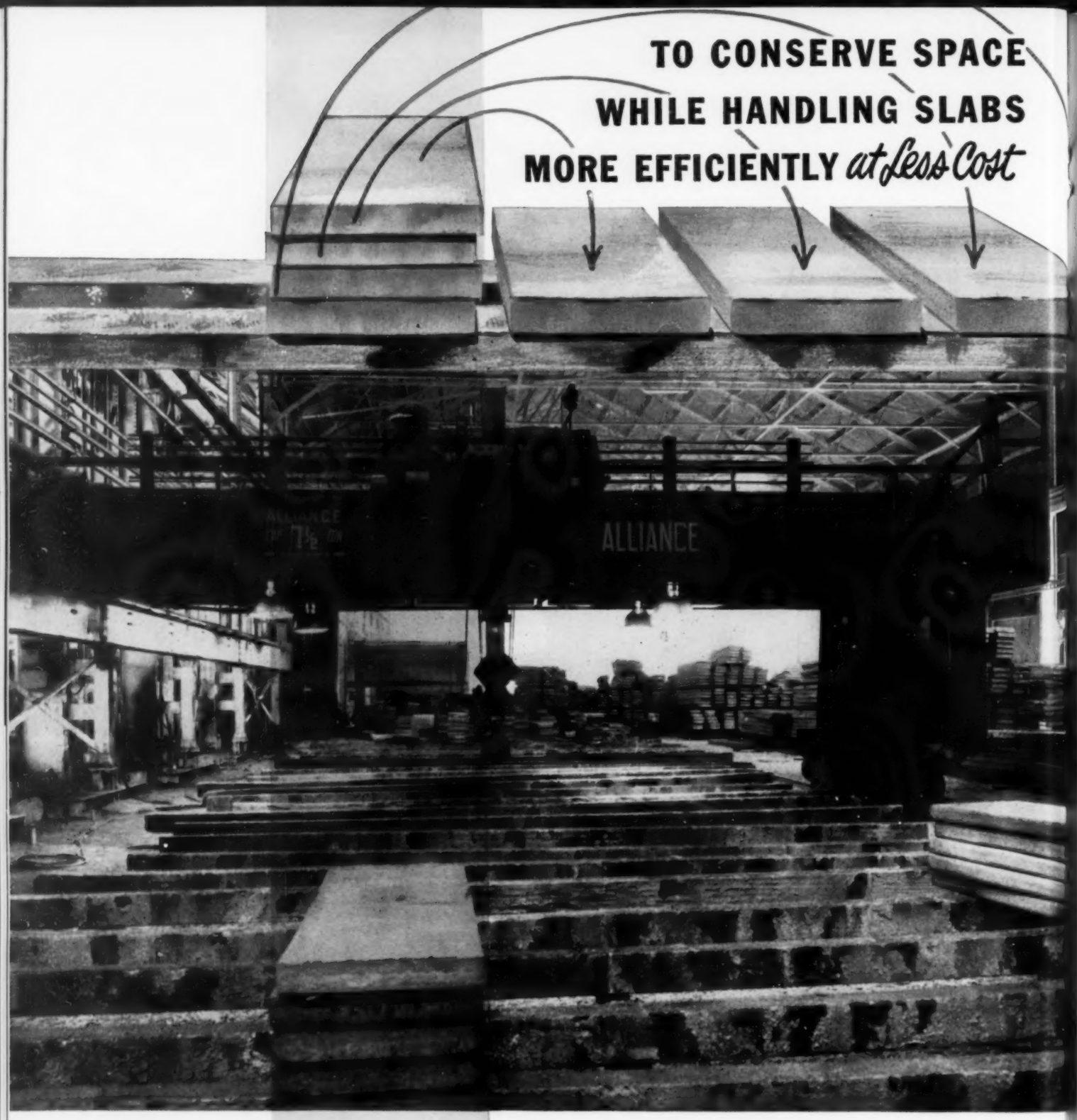
Westinghouse

IF YOUR PRODUCT CALLS FOR HEAT-TREATING . . .
IT CALLS FOR A WESTINGHOUSE FURNACE . . . GAS OR ELECTRIC



This sub-mounting of Westinghouse cylindrical bell-type furnace bases makes motors and controls easily accessible.

These pyrometers and mounting panels at the Thompson Wire Co. control and indicate furnace temperatures. Note alarm horns.



Alan Wood Steel Company uses *Alliance* telescopic crane

Alliance

LADLE CRANES • GANTRY CRANES • FORGING MANIPULATORS
SOAKING PIT CRANES • STRIPPER CRANES • SLAB AND BILLET
CHARGING MACHINES • OPEN HEARTH CHARGING MACHINES
SPECIAL MILL MACHINERY • STRUCTURAL FABRICATION

THE ALLIANCE MACHINE COMPANY
Main Office, Alliance, Ohio ★ Pittsburgh Office, 1622 Oliver Building

● Operating underneath the main overhead crane, this newly developed, stiff-leg, semi-gantry, 7½ ton Alliance Slab Handling Crane services the slab storage area of the building as it turns and positions heavy slabs on the scarfing bed.

A minimum of headroom is required as this Alliance crane utilizes a special telescopic ram rather than a rack type ram to conserve overhead space. And, because of the compact design, this type crane can be installed where the rack type could not because it requires more headroom. The operator is located on the gantry leg level with his work for perfect visibility.

Alliance, with more than a half-century of crane building experience behind them, is continually developing new ways to give industry added lifting power at reduced costs. Call in your Alliance engineer today for a frank discussion of your heavy material handling problems. Be prepared now and tomorrow.

4-HIGH REVERSING
ROUGHING STAND
FOR
HOT STRIP MILL

designed and built by

UNITED

ENGINEERING AND FOUNDRY COMPANY

PITTSBURGH, PENNSYLVANIA

Plants at • Pittsburgh • Vandergrift • Youngstown • Canton • Wilmington (Lobdell United Division)

SUBSIDIARIES: Adamson United Company, Akron, Ohio
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Designers and Builders of Ferrous and Non-Ferrous Rolling Mills, Mill Rolls, Auxiliary Mill and Processing Equipment, Presses and other heavy machinery. Manufacturers of Iron, Nodular Iron and Steel Castings and Weldments.

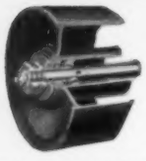
7 solid reasons why it pays to standardize on LINK-BELT IDLERS

1 STRONG, RIGID FRAMES support rolls in perfect alignment. Rolls are securely held in place but can be easily removed for inspection and service.

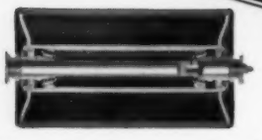
2 CONCENTRIC ROLLS have smooth surfaces and rounded edges. Machine-made, continuous welds prevent entrance of dirt and moisture—assure hop-free rotation.

3 HUSKY, HIGHEST QUALITY BEARINGS, free and easy turning, provide concentricity and perfect alignment for smooth operation, minimum belt wear, low power requirements.

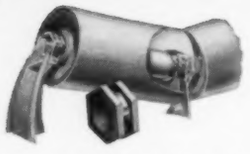
4 SAFE, CONVENIENT GREASE FITTINGS provide ease of lubrication. Extensions can be furnished for greater accessibility in out-of-the-way locations.



5 POSITIVE, COMBINATION GREASE SEAL unit retains lubricant, prolongs bearing life. The most effective seal offered in idlers today!



6 ROLLS consist of a counterbored outer shell plus a full-length, heavy central tube of $\frac{3}{16}$-in. steel. Both tube and shell are welded to dished steel heads to maintain balance and bearing alignment.



7 HEX NUTS provide bearing adjustment at shaft ends and prevent rotation in service. Nuts prevent bracket from spreading under unusual impact.

Get the right idler from industry's most comprehensive line

Link-Belt makes more than 500 belt conveyor idlers in 34 types. You can select from light, medium or heavy-duty 20° troughing idlers, two types of 45° idlers, flat belt, belt training, rubber cushion and the new Link-Belt variable troughing idler. Most are built in a broad range of roll diameters and belt widths with matching return idlers. Ask your Link-Belt sales representative or distributor for new 48-page Book 2416.

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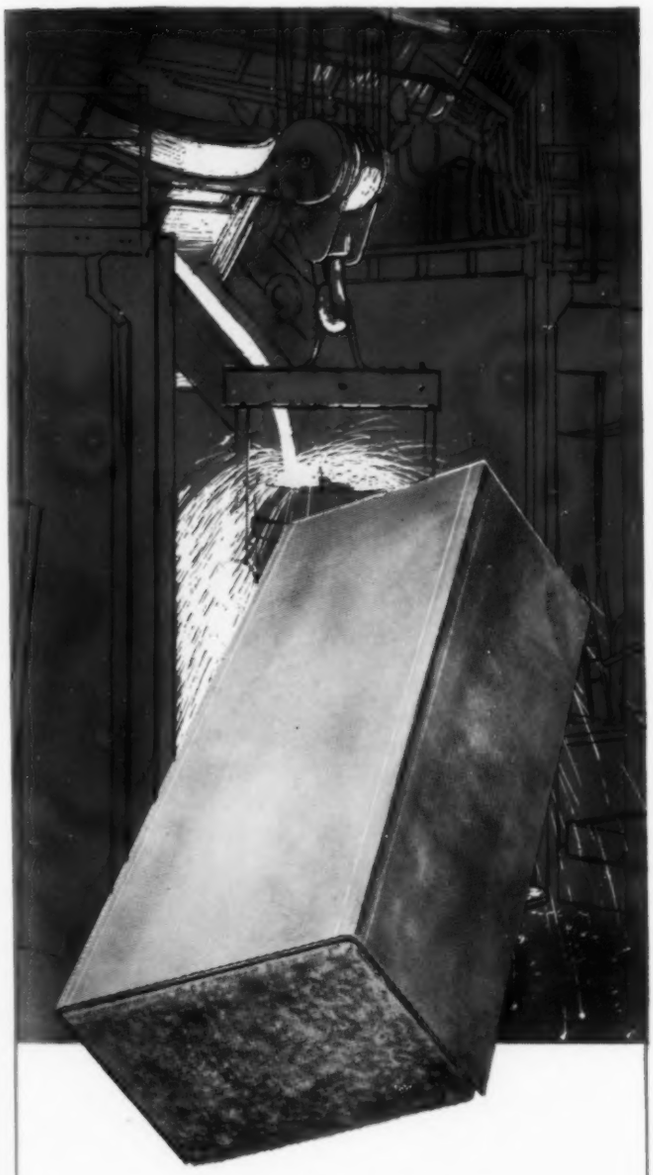
LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants, Sales Offices, Stock Carrying Factory Branch Stores and Distributors in All Principal Cities. Export Office: New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World. 19,415

USED BY 71%

OF ELECTRIC FURNACE OPERATORS



Permanente PERICLASE Brick for the Steel Industry:

- Permanente Periclase Brick (D-S)
- Permanente Periclase Chrome Brick (PCA)
- Permanente Chrome Periclase Brick (CPA)

Now available! A companion mortar for Permanente D-S brick. High purity periclase composition *and* maximum workability.

Installation advice on request

Permanente Periclase-Chrome Brick is used to line 71% of all basic electric steel furnaces west of the Mississippi River and in all of Mexico—the area where this superior brick has been available for the longest time.

In all other areas where Permanente Periclase-Chrome Brick has more recently been introduced, it is gaining acceptance at an even faster rate.

Of course, there's a reason. It is simply that the special composition of Permanente Periclase-Chrome Brick has greatly lengthened the life of electric furnace sidewalls—by a minimum of 10% . . . and in some operations even up to 200%.

These performance records are derived from a wide variety of shops melting all types of electric steel. No matter what your operation, Permanente brick should lengthen sidewall life.

Your Kaiser Chemicals sales engineer can give you complete technical details on Permanente Periclase-Chrome Brick, and explain why it can lengthen the life of your electric furnace sidewalls. He is available to assist you in its proper installation in your electric furnace.

• • • • • • • • • • • • • • •

Call or write Kaiser Chemicals Division, *Kaiser Aluminum & Chemical Sales, Inc. Regional Sales Offices: 1924 Broadway,* OAKLAND *12, California . . . First National Tower,* AKRON *8, Ohio . . . 518 Calumet Bldg., 5231 Hohman Avenue, Hammond, Indiana* (CHICAGO).

Kaiser Chemicals

Pioneers in Modern Basic Refractories

Basic Refractory Brick • Ramming Materials • Castables & Mortars • Magnesite • Periclase • Deadburned Dolomite

This Transformer Delivers

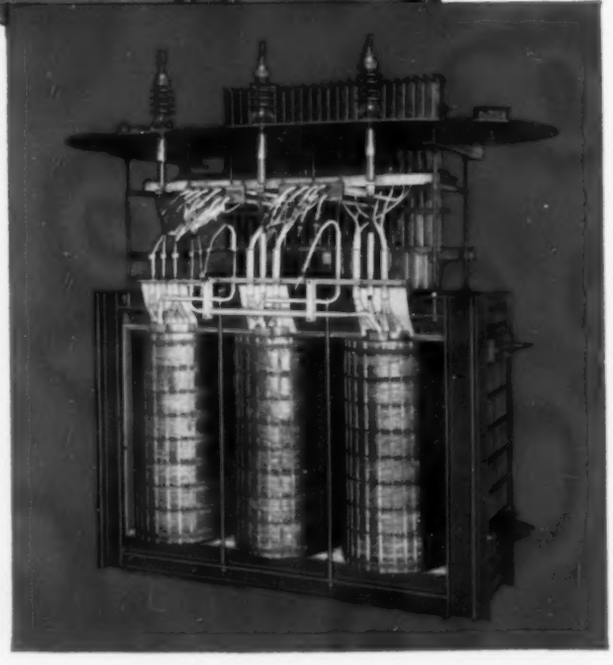
33,962 Amperes

Providing high continuous current for specialized steel processing is an everyday duty for this transformer. Its well-balanced design and sturdy construction is based on past records of Allis-Chalmers transformers which show ability to withstand as much as 25 to 30 years of the repeated daily short circuits encountered in furnace operation. Allis-Chalmers has been building arc furnace transformers for over 45 years.

In addition to furnace transformers in any rating up to the largest demanded by the industry, Allis-Chalmers builds a complete line of arc furnace electrical equipment, including electrical control, circuit breakers, and auxiliary transformers.

Next time you consider a new or replacement arc furnace transformer, consult the Allis-Chalmers district office nearest you or write Allis-Chalmers, Milwaukee 1, Wis.

A-4318



One of three 20,000-kva arc furnace transformers recently built by Allis-Chalmers for a large eastern steel manufacturer. Each can deliver a continuous current of 33,962 amperes per phase. Picture at right shows core and coil assembly.

- Extremely heavy supports brace coils against severe short circuit stresses.
- Skilful insulation techniques protect windings from overvoltages due to wide tap range. Some units are designed for as much as 50% range in secondary voltages.
- Tap-changing mechanism, specially designed for furnace transformers, is in separate compartment to facilitate periodic inspection and maintenance. Wide, flat contacts provide the long life needed for numerous daily tap-changing operations. Mechanism can be either motor driven or manually operated.
- Grit blasting and three coats of baked-on alkyd resinous paint give transformer good surface protection against industrial corrosion.

ALLIS-CHALMERS

Patent Reviews

By MELVIN NORD
Patent Attorney
Detroit, Mich.

. . . . copies of patents may be obtained from the Commissioner of Patents, Washington 25, D. C., at 25 cents each . . . . patents reviewed cover period November 2, 1954 through November 23, 1954 . . . .

PICKLING STEEL WITHOUT WASTE DISPOSAL PROBLEMS

▲ U.S. 2,694,657, issued November 16, 1954 to Nils H. Brundin and assigned to Ekstrand & Tholand, Inc., describes a pickling process using ammonium bisulphate as the pickling agent, which includes recovery of the dissolved iron and re-use of the pickling liquor. Waste disposal problems are eliminated.

A concentration of 100 to 450 grams per liter of ammonium bisulphate is used in the pickling operation, at a temperature of about 70 C or higher.

One of the methods of regenerating the solution and recovering the iron involves adding ammonia to the spent pickling solution under oxidizing conditions, as by blowing air into the solution. The dissolved iron is precipitated as ferric hydroxide in an easily filterable form. The filtrate is evaporated to yield ammonium sulphate. This is heated to yield ammonia and solid ammonium bisulphate.

PARTIAL REDUCTION OF IRON ORE

U.S. 2,692,050, issued October 19, 1954 to Karl J. Nelson, and assigned to Standard Oil Development Co., describes a process for reducing the Fe_2O_3 content of lean iron ores to Fe_3O_4, preparatory to concentration using wet magnetic separation methods. The process is said to be made economical by producing a lean producer gas in situ by contacting ore, low-grade coal or lignite, and air in a circulating bed system. The heat evolved in burning most of the fuel to CO_2 is used to heat the ore, and the CO produced reduces the Fe_2O_3 to Fe_3O_4.

PARTIAL REDUCTION OF IRON ORE

U.S. 2,693,409, issued November 2, 1954 to Frank M. Stephens, Jr., and assigned to Battelle Memorial Institute, provides another method for partial reduction of iron ore preparatory to magnetic concentration.

The iron ore is preheated to a temperature of at least 660 F. It is then reduced to magnetite, and then suffi-

OTHER PATENTS OF INTEREST TO THE IRON AND STEEL ENGINEER

Patent No.	Date	Subject	Inventor or Assignee
2,693,353	11/ 2/54	Forced circulation cooling apparatus for continuous strip furnaces	The Electric Furnace Co.
2,693,411	11/ 2/54	Method of purifying molten pig iron	Frederick Cremer
2,693,412	11/ 2/54	Alloy steels	Colvilles Ltd.
2,693,413	11/ 2/54	Alloy steels	Firth-Vickers Stainless Steels Ltd.
2,693,632	11/ 9/54	Manufacture of seam-welded steel tubes	Louis Heussner
2,693,886	11/ 9/54	Apparatus for loading cupolas	Grindle Corp.
2,693,887	11/ 9/54	Cupola charging apparatus	Modern Equipment Co.
2,693,919	11/ 9/54	Apparatus for coiling rolled strip	The Loewy Engineering Co., Ltd.
2,693,952	11/ 9/54	Forge furnace control	Surface Combustion Corp.
2,694,001	11/ 9/54	Polishing stainless steel	Armco Steel Corp.
2,694,097	11/ 9/54	Electric smelting equipment and method of using it	Elektrokemisk A/S
2,694,246	11/16/54	System for heating billets	Selas Corp. of America
2,694,626	11/16/54	Stainless steels	Armco Steel Corp.
2,694,627	11/16/54	Rivet steel	Bethlehem Steel Co.
2,694,741	11/16/54	Electrically heated annealing furnace base	Armco Steel Corp.
2,695,098	11/23/54	Method and apparatus for inspecting sheets	United States Steel Corp.
2,695,142	11/23/54	Collapsible take-up spool for coiling wire	United States Steel Corp.
2,695,229	11/23/54	Chrome-nickel hardenable stainless steel	Allegheny Ludlum Steel Corp.

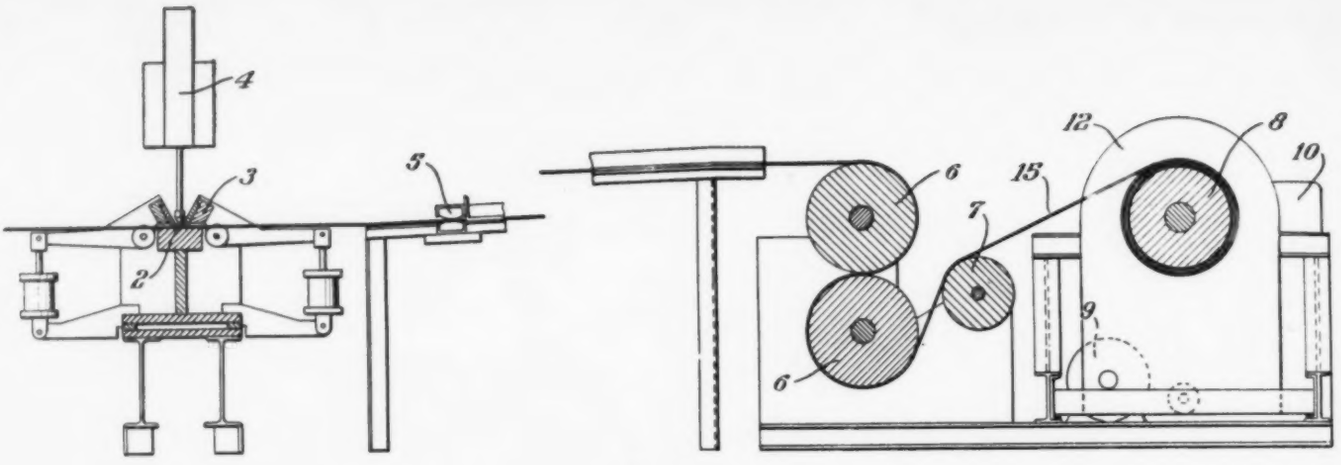


Figure 1

cient magnetite is re-oxidized to magnetic hematite to provide heat to preheat additional ore to at least 660 F for reduction. The patent describes the method and an apparatus for carrying it out in some detail.

COILING SILICON STEEL STRIP

Silicon steel in sheet or strip form is very stiff and subject to tearing under heavy tension. Because of its stiffness it cannot be coiled in the conventional way. The strip does not form uniformly into a coil but tends to weave back and forth in the direction of the axis of the coil, forming an uneven and commercially unsatisfactory coil. In U.S. 2,691,819, issued October 19, 1954, John M. Felton and Clarence H. Verwohlt claim to have found the solution to the problem. The patent is assigned to Wheeling Steel Corp.

The silicon steel is coiled by feeding the strip to a reel, rotating the reel to coil the strip, and during rotation of the reel engaging the strip and pulling backward on it so that the strip is coiled under heavy tension, insuring formation of a straight, even coil. At the tensioning station, the strip is subjected to a stress-relieving heat treatment to render it less subject to tearing.

The apparatus is shown in elevation, partly in cross-section in Figure 1. There is shown at 2 a bonding or welding station where sheets are welded end-to-end to form strip. The sheets are advanced from the left toward the right. The sheets are clamped in position for bonding by clamping means 3. There is shown a traveling welder head 4 which travels along the joint between the edges of the clamped sheets to weld the edges together.

The strip moves to the right from the bonding station through a drag wiper 5, about a pair of rubber covered bridle rolls 6, over a steel idler roll 7 and to a reel 8 where the strip is formed into a coil by turning of the reel. The reel 8 is driven by an electric motor 9 through a gear reduction unit 10. The reel may be provided with a brake, not shown, which holds the reel against turning when the motor is deenergized.

The upper and lower rubber covered bridle rolls 6 constitute strip tensioning means and the location at which they and the idler roll 7 are placed is a tensioning station. The upper roll 6 is an idler but the lower roll 6 is connected to a motor which tends to rotate it in the clockwise direction, i.e., in such a direction as to tend to draw the strip 15 backwardly or toward the left away from the reel 8, thereby applying heavy tension to the strip, insuring formation on the reel 8 of a straight, even coil. The lower roll 6 has a sufficiently large area of contact with the strip to enable the roll to exert a strong frictional drag on the strip, the upper roll 6 insuring maintenance of the strip in proper relation to the lower roll 6 to accomplish the result. Normally the motor does not actually turn the lower roll 6 in the clockwise direction; on the contrary, despite the tendency of the motor to turn the lower roll 6 in the clockwise direction, that roll actually turns in the counterclockwise direction due to the frictional pull exerted on it by the strip as it is drawn by the reel. However, the motor does insure maintaining the strip under heavy tension at all times.

METHOD OF CASTING TITANIUM STABILIZED STEEL

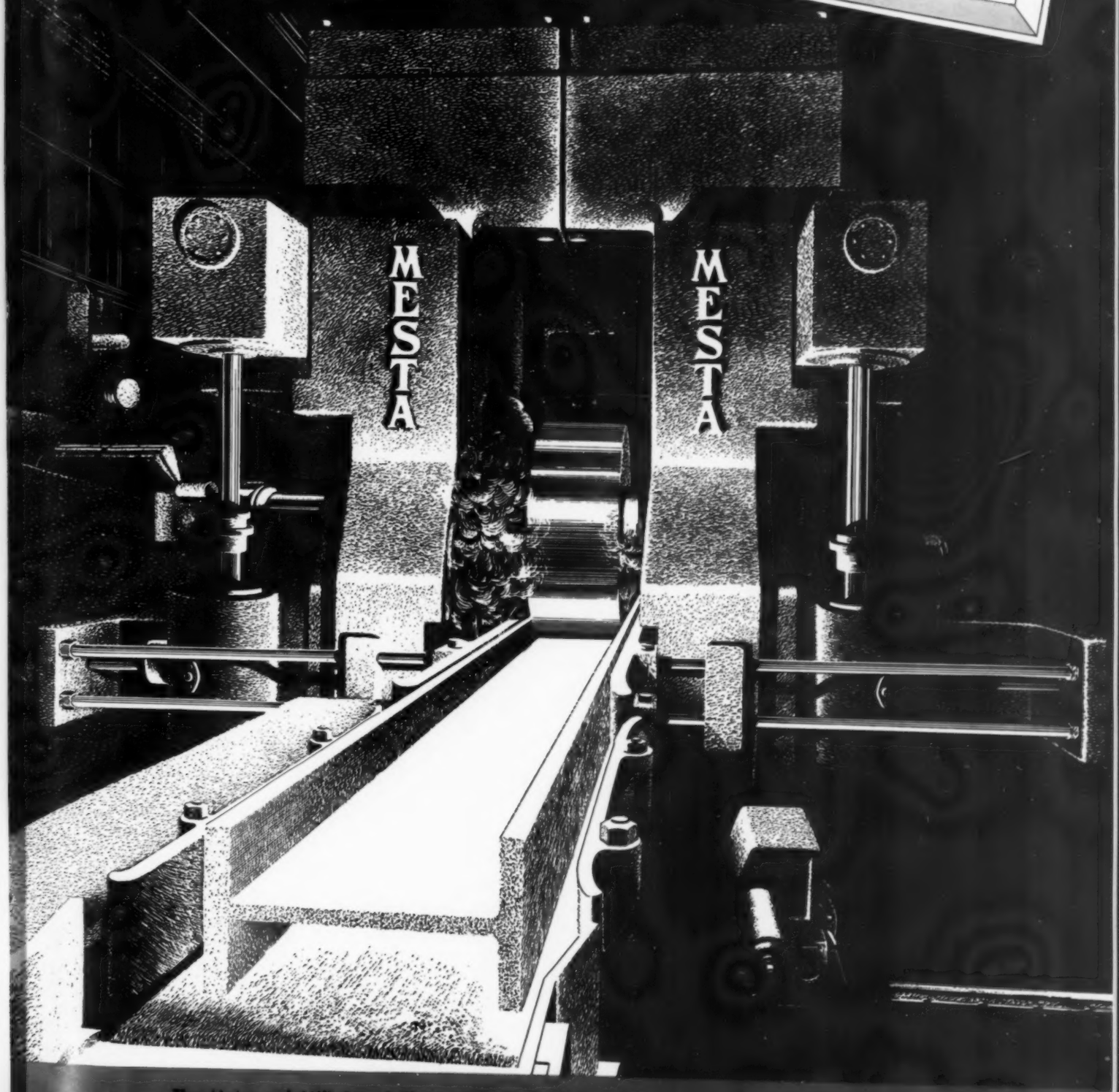
U.S. 2,693,414, issued November 2, 1954 to Walter H. Dunn and John C. Southard, and assigned to Solar Aircraft Co., describes a method of producing stainless steel castings capable of commercial use as cast, and containing titanium as a stabilizing agent.

The furnace charge is deoxidized completely with strongly reducing aluminum-free compounds just prior to tapping. Ferro-titanium alloy containing less than 4 per cent aluminum by weight is then added to the charge while in a completely deoxidized condition, and the charge is then poured immediately into a sand mold.

Are you annoyed by having someone borrowing your magazine when you want it? Get him to join the AISE.

WIDE FLANGE BEAM and STRUCTURAL MILLS

Designed and Built by MESTA



The Universal Mill Stand illustrated above is one of the units comprising the new MESTA Beam Mills being built for the Inland Steel Company, Indiana Harbor Works.

DESIGNERS AND BUILDERS OF COMPLETE STEEL PLANTS

MESTA MACHINE COMPANY • PITTSBURGH, PA.

"Steel from the Furnaces." Agnes Potter Lowrie depicts some of the basic steel products which provide the sinews of American industry. The I-beam, key piece in building construction. The angle iron. Wire rope. Railway track to carry the carriers of industry. The can, universal container for foods and liquids. And in the background, sheet steel, gleaming symbol of strength and durability. Limited edition of 15 x 18 full-color prints available. Copy on request.

The Fine Art of Steel Making #II

Too often, estimates of the steel industry concentrate upon our overwhelming productive capacity. Yet more than a little credit is due another American talent—the ingenuity of research coupled with the ever-readiness of steelmen to adopt new and better products and processes.

As recently as World War II, some of our largest mills were fearful of shutdowns because palm oil, then considered the essential lubricant for cold rolling tin plate, was obtainable only from foreign sources and had to be imported across U-boat-infested waters.

Research tackled the problem. Three years ago Ironsides announced Palmoshield as the first domestic replacement for imported palm oil. Within six months two-thirds of our major tin plate mills were using or testing it, often with remarkable results. For example, one company stepped up production 15% with no additional investment, no increase in labor, and no change in mill operation.

Recognized as today's most significant advance in lubrication, Palmoshield offers five distinct advantages:

1. Produced in the heart of the steel industry. Users need not stockpile.

2. Made from freely available domestic materials.

3. Subject to exact chemical control — free fatty acid content to within ½%.

4. Price is not artificial, but fluctuates freely with the domestic fat market.

5. Proved in production to deliver increased tonnage at less cost.

Ironsides research, which developed Palmoshield, is geared to the future. A flexible team — the "custom tailors" of lubrication — Ironsides engineers are available for technical assistance on special problems of any nature or size.

A letter will summon them without obligation. Address The Ironsides Company, Columbus 16, Ohio.

SHIELD PRODUCTS

Ironsides

By the makers of Palmoshield • "the palm tree that grows in Ohio"

EC&M TAB WELD resistors

TRADE MARK

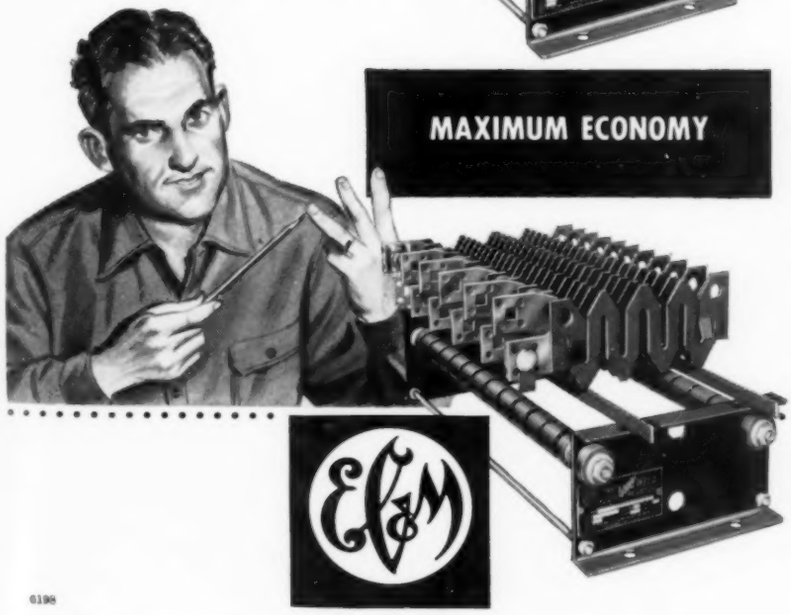
GIVE YOU:

ADAPTABILITY

EC&M TAB-WELD Plate Resistors are easy to select and use for controller, starter or similar service. There are several standard mill sections to choose from and each section has many convenient tap-plates. This allows quick clamping to external connections and gives a choice of adjustments. When necessary for high capacity, sections can be easily paralleled externally. These same advantages reduce down-time when old existing sections are replaced with TAB-WELD Resistors.

DEPENDABLE PERFORMANCE

These EC&M Resistors are non-breakable and are made from corrosion-resistant steel. WELDING joins offset grid ends to assure a continuous current-carrying path. WELDING also stabilizes ohmic value independent of the clamping-nut pressure and stops burning at grid-eyes and tap-plates. Terminal-plates, also WELDED in place, simplify tap connections . . . tap-shifting.



MAXIMUM ECONOMY

EC&M TAB-WELD Plate Resistors cut costs and save manpower. Ease of selection and application reduce engineering time. Installation is quick and maintenance is practically nil . . . there's no need for periodic tightening of clamping nuts. EC&M TAB-WELD Plate Resistors are easy to specify because they are built in only one style . . . WELDED for top performance.

Write for informative Bulletin 942-B

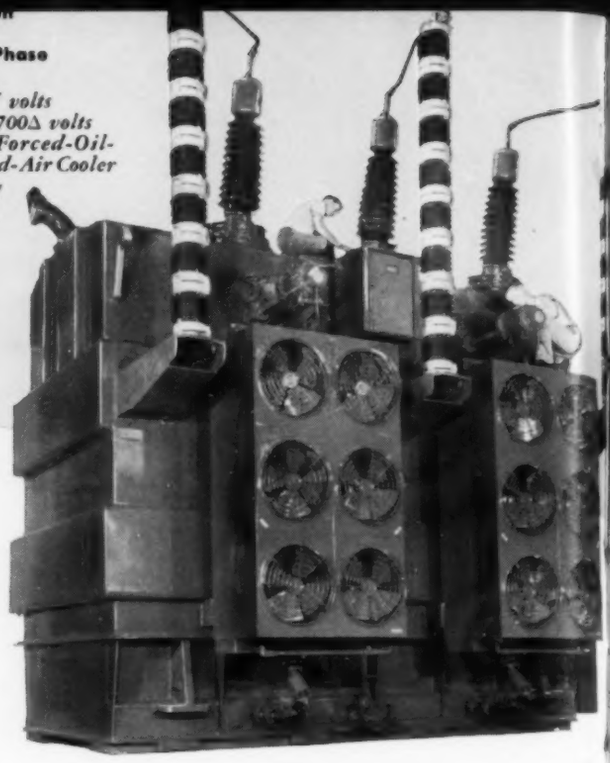
THE ELECTRIC CONTROLLER & MFG. COMPANY

2698 East 79th Street • Cleveland 4, Ohio

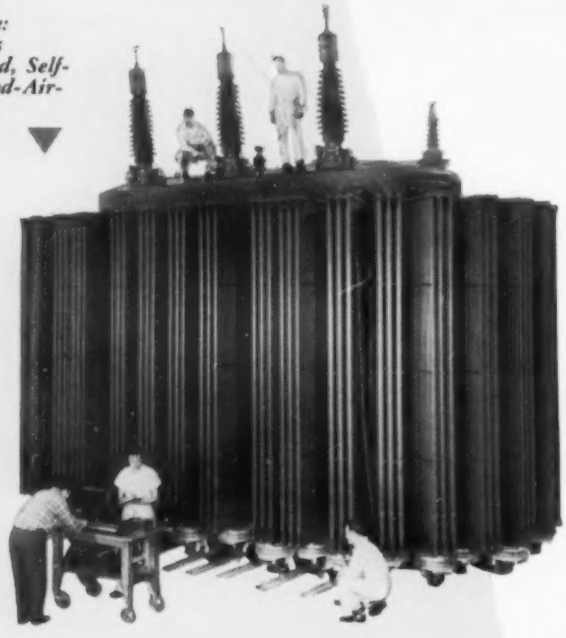
0198

Generating Station Transformer
56,000/70,000 Kva, Single Phase
High Voltage: 161,000 Grd. Y/ 93,000 volts
Low Voltage: 19,000 volts
Oil-Immersed, Self-Cooled Forced-Air-Cooled

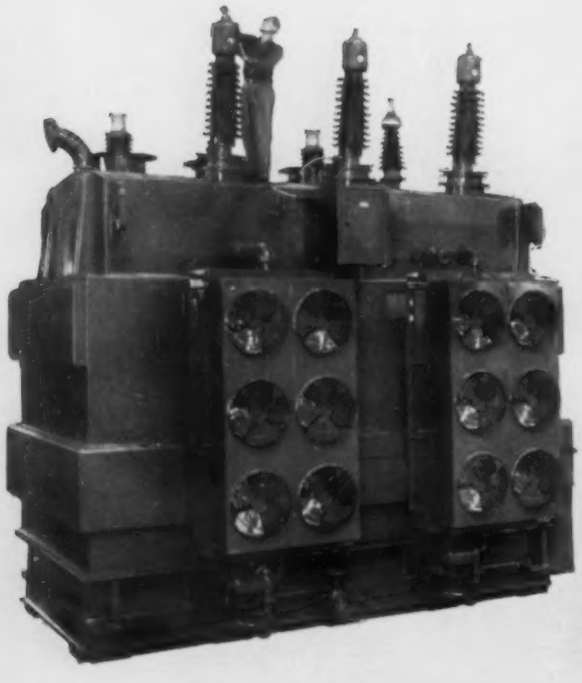
Generating Station Transformer
140,000 Kva, 3 Phase
High Voltage: 115,000 Grd. Y volts
Low Voltage: 14,700Δ volts
Oil-Immersed, Forced-Oil-Cooled with Forced-Air Cooler



Generating Station Transformer
68,000/90,666 Kva, 3 Phase
High Voltage: 132,000 Grd. Y/ 76,200 volts
Low Voltage: 13,200Δ volts
Oil-Immersed, Self-Cooled/Forced-Air-Cooled

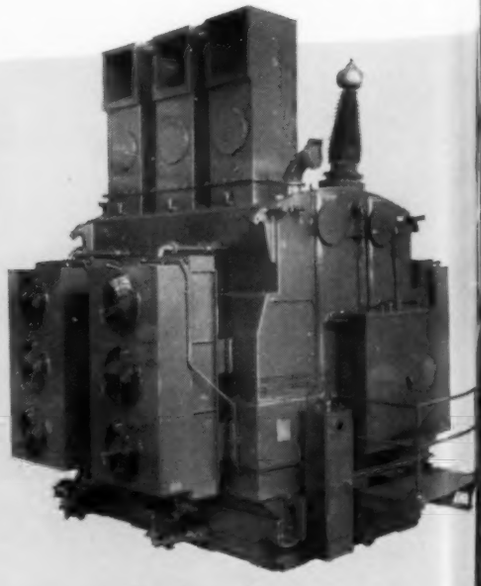


REPRESENTATIVE Power Transformers MANUFACTURED BY PENNSYLVANIA IN 1954

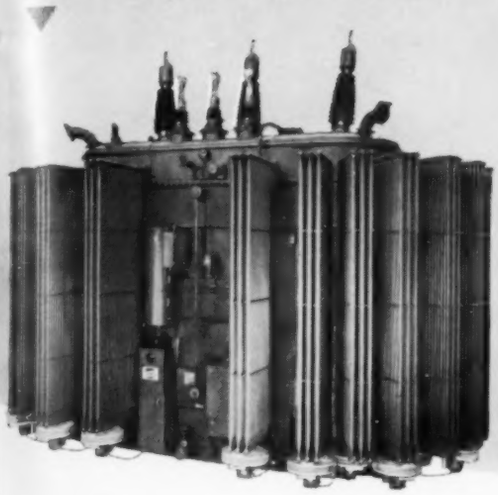


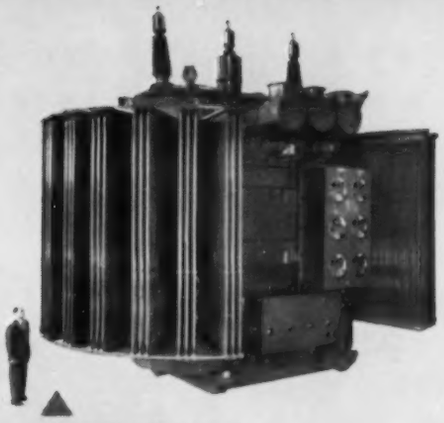
Generating Station Transformer
175,000 Kva, 3 Phase
High Voltage: 115,500 Grd. Y volts
Low Voltage: 17,500Δ volts
Oil-Immersed, Forced-Oil-Cooled with Forced-Air Cooler

Generating Station Transformer
120,000 Kva, 3 Phase
High Voltage: 145,000 Grd. Y volts
Low Voltage: 19,800Δ volts
Oil-Immersed, Forced-Oil-Cooled with Forced-Air Cooler



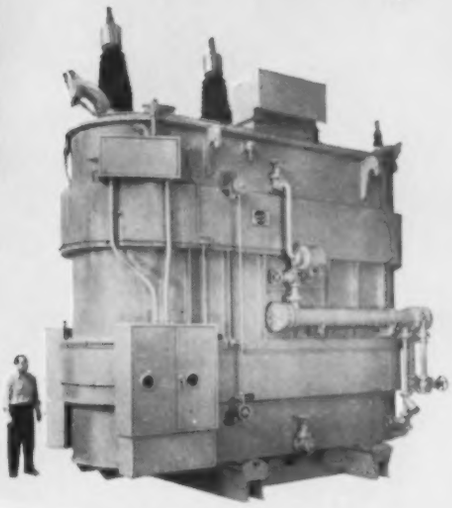
Generating Station Transformer
56,000/70,000 Kva, 3 Phase
High Voltage: 132,000Y volts
Low Voltage: 15,000Δ volts
Oil-Immersed, Self-Cooled/Forced-Air-Cooled





Substation Transformer
45,000/60,000 Kva, 3 Phase
High Voltage: 125,400Δ volts
Low Voltage: 13,800Y volts
Oil-Immersed, Self-Cooled/Forced-Oil-Cooled with provision for future OA/FOA/FOA rating of 75,000 Kva

Generating Station Transformer
48,000 Kva, 3 Phase
High Voltage: 115,000 Grd. Y volts
Low Voltage: 13,200Δ volts
Oil-Immersed, Forced-Oil-Cooled with Forced-Water Cooler

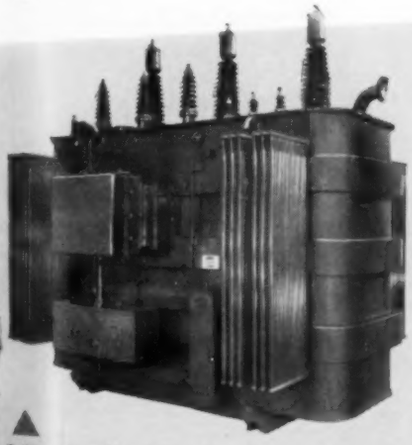


Here are some of the single phase and three phase power transformers manufactured by Pennsylvania in 1954. They are representative of the large core-form and contour-design (shell-form) transformers that are preferred by leading utilities and industrials. Some of these units are for generating station service. Others are typical power transmission transformers. Every type of cooling method is represented in these transformers. Typical accessories include load tap changing mechanisms, lightning arresters, and potential devices. In short, these transformers represent Pennsylvania's complete coverage for the large power transformer needs of this country.

Expanded plant facilities also made it possible for Pennsylvania to offer transformers in ratings up through 350,000 Kva and in voltages through 330 Kv. This includes load tap changing transformers up to 150,000 Kva.

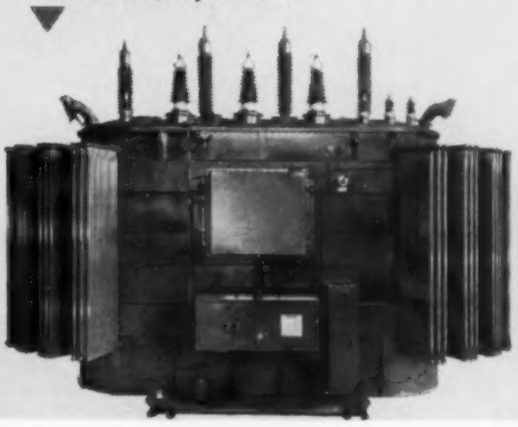
It is significant, too, that 1954 was a record-breaking production year at Pennsylvania, indicating in a concrete manner the trust placed in Pennsylvania Transformer Company, its people and its products.

PENNSYLVANIA TRANSFORMER COMPANY . CANONSBURG, PA.
A McGraw Electric Company Division

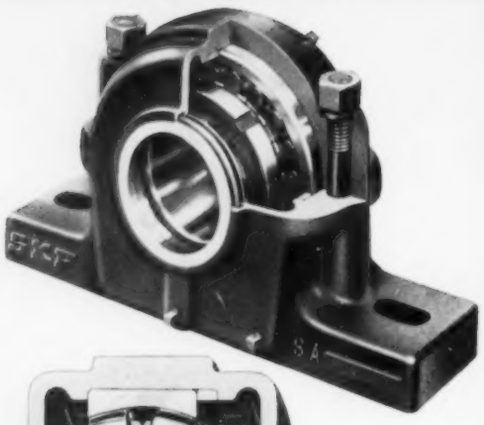


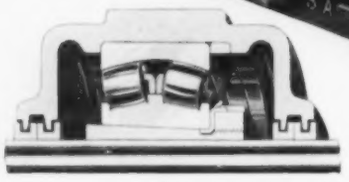
Substation Transformer
15,000 Kva, 3 Phase, with load tap changing equipment
High Voltage: 154,000Y volts
Low Voltage: 69,000 Grd. Y volts with plus and minus 10% regulation in 32–⅝% steps
Tertiary Voltage: 12,470Δ volts
Special design for shipping in one-piece tank

Substation Transformer
25,000 Kva, 3 Phase, with load tap changer
High Voltage: 138,000Y volts
Low Voltage: 69,000 Grd. Y volts with plus and minus 10% regulation in 32 — ⅝% steps
Tertiary Voltage: 12,400Δ volts
Oil-Immersed, Self-Cooled



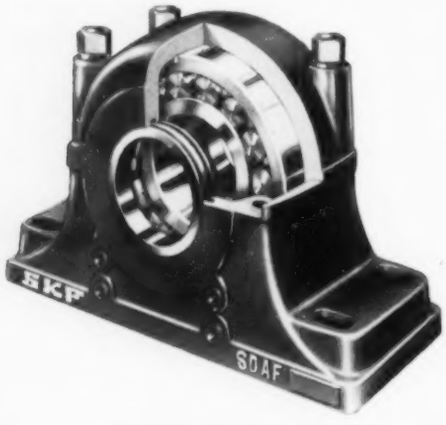
Substation Transformer
30,000 Kva, 3 Phase, with load tap changing equipment
High Voltage: 66,000Y volts, with plus and minus 5% regulation in 32 — 5/16% steps
Low Voltage: 33,000Y volts
Tertiary Voltage: 13,800Δ volts
Oil-Immersed, Forced-Oil-Cooled with Forced-Air Cooler





SAF SPLIT PILLOW BLOCK

Self-aligning. Sizes for shafts from ¼" to 7-15/16". Ball or roller bearings. Adapter or "press on shaft" mounting. Cast steel as well as gray iron housings available.



SDAF SPLIT PILLOW BLOCK

For every heavy load condition. Halves accurately aligned by step-joint and dowel pins. For shafts from 2-11/16" to 7-15/16" for adapter or "press on shaft" mounting. Cast steel as well as gray iron housings available.

Check the Facts on SKF

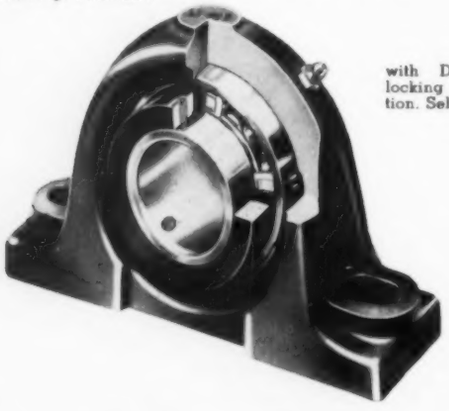
BALL AND ROLLER

PILLOW BLOCKS

from Your Authorized Source

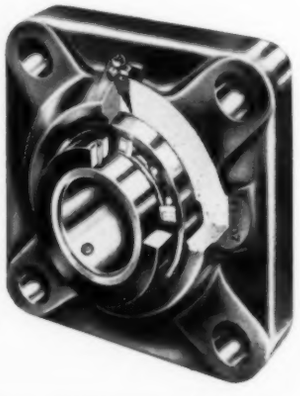
Bearings, Inc.

For every duty range—light, medium, heavy and extra heavy. Spherical roller or ball bearing equipped. Either adapter mounted or "press fit on shaft." Wide choice of housing designs—split or unit type. For every application there is an SKF Pillow Block for the job—ask for one of our Bearing Engineers to show you how SKF can answer most bearing problems now!



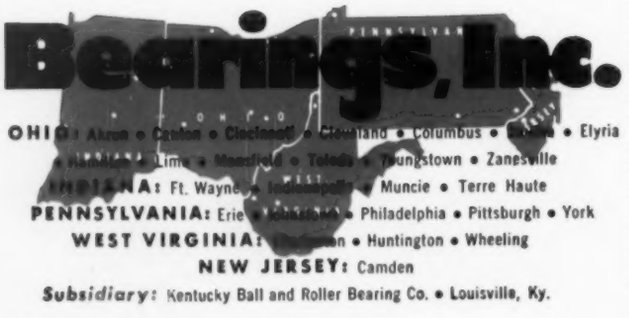
SY PILLOW BLOCK

with DuPont "Fairprene" Seals. Separate locking collar with set screws for easy installation. Self-aligning.



FY FLANGED MOUNTING PILLOW BLOCK

with SKF Red Seals. Keeps lubricant in, and rotating flingers keep dirt out. Spherical outer ring provides initial alignment.


Bearings, Inc.
OHIO: Akron • Canton • Cincinnati • Cleveland • Columbus • Dayton • Elyria
Lima • Mansfield • Toledo • Youngstown • Zanesville
INDIANA: Ft. Wayne • Indianapolis • Muncie • Terre Haute
PENNSYLVANIA: Erie • Philadelphia • Pittsburgh • York
WEST VIRGINIA: Huntington • Wheeling
NEW JERSEY: Camden
Subsidiary: Kentucky Ball and Roller Bearing Co. • Louisville, Ky.

BEARINGS, INC., 3634 Euclid Ave., Cleveland 15, Ohio

Gentlemen:

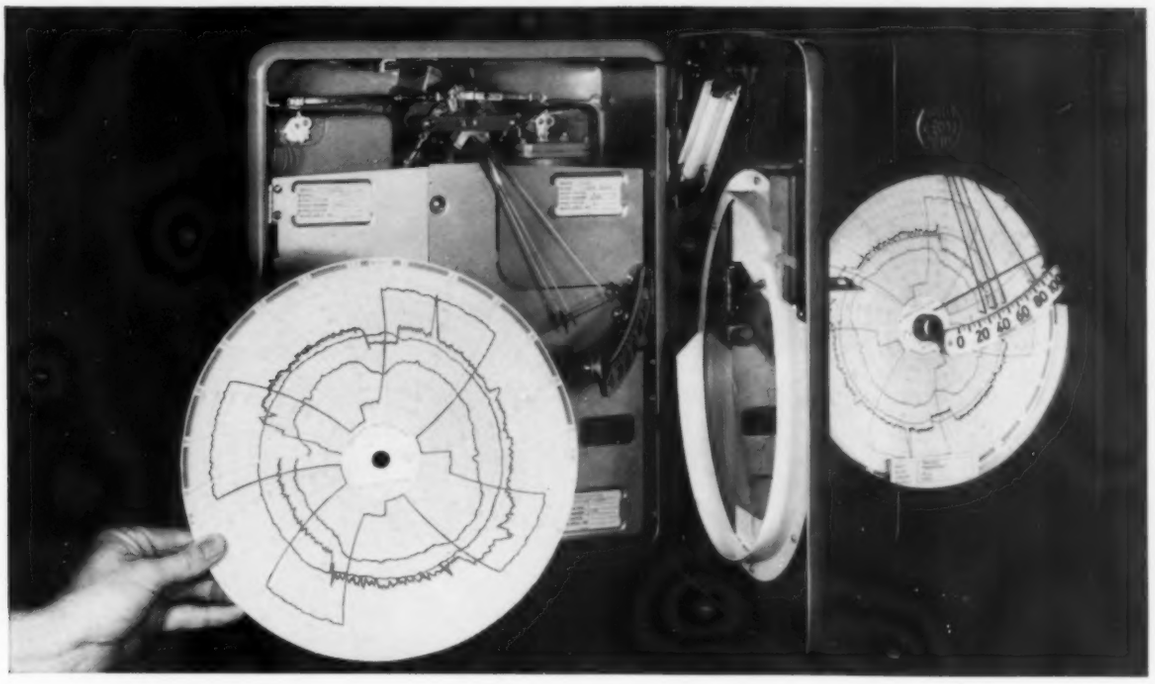
I would like to have complete information on your line of SKF Pillow Blocks.

Name .....

Firm .....

Address .....

City ..... Zone ..... State .....



Faithfully yours –

Clear, Continuous Records without Poisoning . . . on the New Bailey Recorder

★ Faithful chart records of measured variables are the key to a meaningful, dependable analysis of operating trends and conditions. Money spent for more accurate metering, for faster response, is money down the drain—*unless* it's matched with chart records that are equally accurate.

That's why these features of the new Bailey Recorder are important to you:

1. Bailey's exclusive sealed capillary-action inking system maintains continuous flow to the pen tip, and traces sharp, opaque, quick-drying records. "Poisoning" of intersecting records is practically eliminated; no blots or smears during operation or chart changing.

2. Pens are mounted on concentric centers, trace on parallel time arcs only 42/1000" apart. This simplifies analysis of two or more records.

3. Interchangeable plug-in receiver units permit practically limitless record-grouping combinations.

Write for Product Specification E12-5 and actual chart sample. P32-1

ONLY BAILEY OFFERS ALL THESE ADVANTAGES IN A SINGLE RECORDER

- Pre-calibrated plug-in receiver units
- Up to four pneumatic or electronic receivers —or two receivers and two integrators
- Any four variables on one chart—easily read and interpreted
- A full year's ink supply at one loading
- Faster shipment—from stock
- Minimum inventory of parts
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Controls for Power and Process

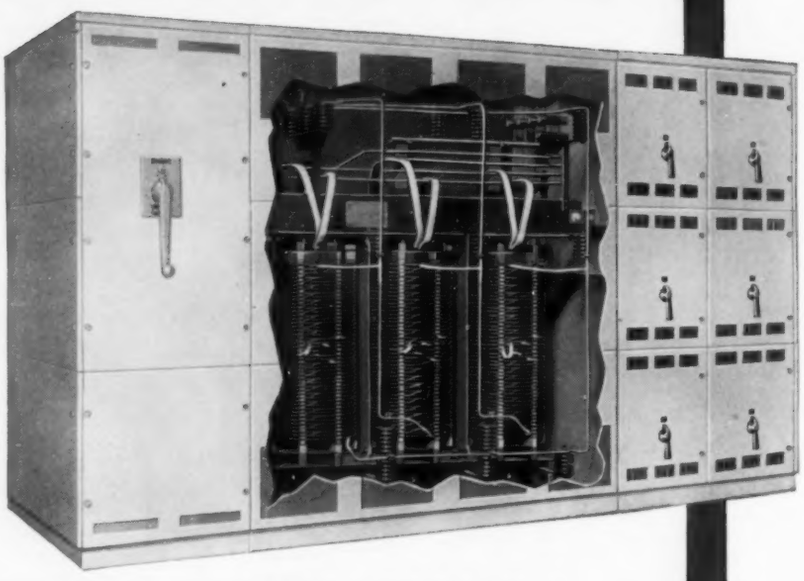
BAILEY METERS
Controls for
TEMPERATURE
PRESSURE
GAS ANALYSIS
FLOW · LEVEL
RATIO · DENSITY

Wagner®
TRANSFORMERS
... the choice of leaders in industry

No matter what your load-center requirements...

you can specify a

Wagner



SUBSTATION TRANSFORMER

PREDESIGNED to meet your needs

- ✓ save shipment time . . .
- ✓ save job engineering costs . . .
- ✓ get full Wagner Quality with switchgear of your choice

Wagner "Predesigned" standard unit substation transformers are carefully engineered to meet *heavy* industrial demands—they are not designed for minimum duty only. Predesigning completely eliminates individual job engineering time . . . reduces your costs . . . and permits quick delivery.

When you specify Wagner "Predesigned" transformers you get the advantages of a proved design in a completely assembled transformer, tested at the Wagner factory. They are built in standard ratings which are coordinated with the specifications of all unit substation builders.

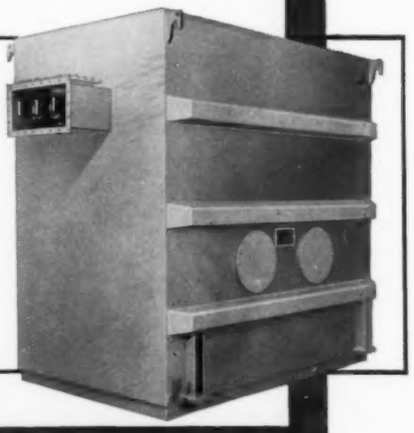
Wagner builds a complete line of substation transformers—open, ventilated Dry-type, Oil-Filled, Noflamol, and sealed-dry-type Nitrogen Filled—in ratings from 112½ through 2000 kva, 15 kv and below, to handle practically any distribution requirements.

You can specify the Wagner Transformer that exactly meets your load-center distribution requirements—be assured of full Wagner Transformer Quality—and gain a substantial advantage in delivery time and in cost.

Investigate the many advantages of specifying Wagner "Predesigned" Unit Substation Transformers for your next load-center installation. Consult the nearest of our 32 branches offices, or write for Wagner Bulletin TU-205. It gives full information on Wagner Unit Substation Transformers for industrial power distribution systems.

SEALED-DRY-TYPE NITROGEN FILLED

Wagner's nitrogen-filled transformers offer many advantages in maintenance and safety. They are relatively unaffected by water—they require only a minimum of maintenance—they present no cleaning problems, even in dust-filled areas. They have exceptionally high overload capacity, and are completely fire and explosion proof. Available in ratings up to 2000 kva.



Wagner Electric Corporation
EST. WE 1891

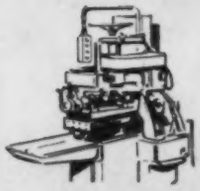
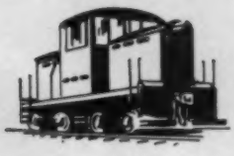
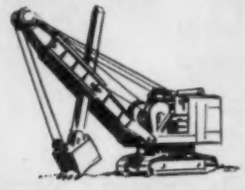
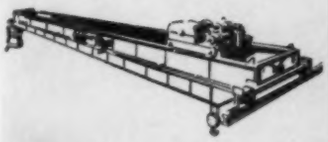
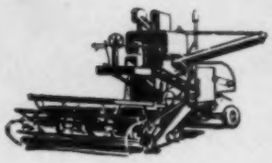
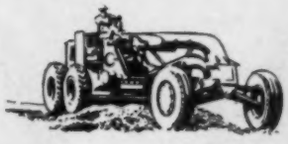
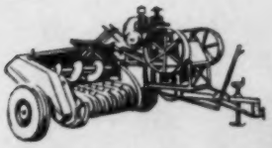
WAGNER ELECTRIC CORPORATION
6483 PLYMOUTH AVE., ST. LOUIS 14, MO., U.S.A.

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

ELECTRIC MOTORS
TRANSFORMERS
INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS—AIR AND HYDRAULIC

T55-1

Industrial Cut Gears

SERVE HYSTER KARRY-KRANES

The dependability of Hyster Lift Trucks is unquestioned. Wherever you go—you see them in a variety of fork and platform arrangements pulling, pushing, transporting or lifting heavy loads to keep production moving and to lower operating expense.

"IG DUROCASE" and "IG-GENERAL SERVICE GEARS" READY TO SERVE YOU TOO!

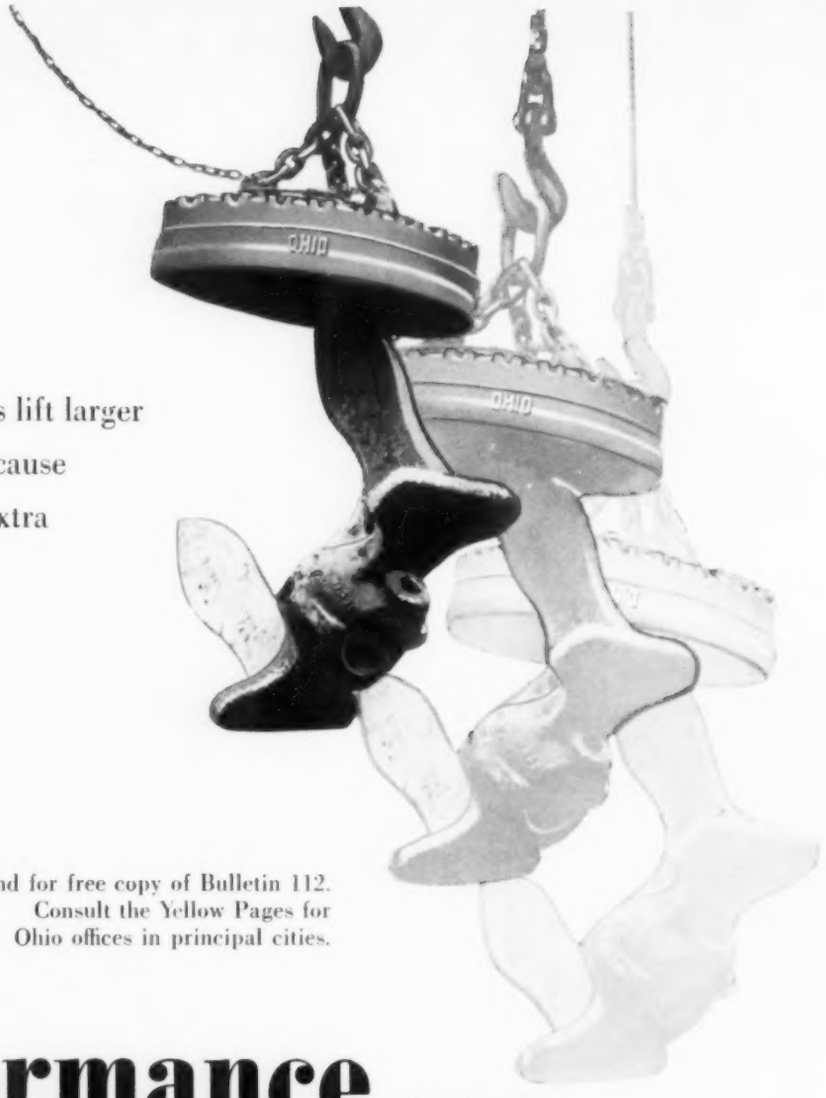
"Industrial" Bronze Worms and Worm Wheels as pictured at right help provide the lifting ability of Hyster Karry Kranes. To maintain the reputation for quality that Hyster enjoys, naturally the Gearing must be the best!

Your requirements for Gears, Sprockets or Splining in our hands will receive the same painstaking care that we give Hyster components.

We serve all Industry providing Herringbones up to 61″ in diameter and 18″ face, including Spurs, Bevels, Mitres, Spirals, Internals and Specials of all sizes for smooth, rugged, long-life operation. Our equipment includes the largest standard Hobber for producing the tip-relieved tooth form gears that prevent interference under heavy load. Schedule your next order our way for friendly "on the beam" service.

Industrial Gear Mfg. Co.

4527 W. VAN BUREN ST. · CHICAGO 24, ILLINOIS



Size for size, Ohio Magnets lift larger loads over longer periods because they *operate cooler*. So for extra magnet lifting power, extra magnet value—always specify Ohio Magnets and Ohio Magnet Controllers. There's a type and size for every lifting job.

Send for free copy of Bulletin 112.
Consult the Yellow Pages for
Ohio offices in principal cities.

for performance . . . it's Ohio Magnets

Ohio Bolted Magnets 12″ to 65″ diameter. 6-coil types in 39″ to 65″; 8-coil in 55″ and 65″. Strap copper coils over 39″. Bolts protected in recessed wells. Also capsule coil over 45″.

Ohio Welded Magnets 39″ to 65″ diameter. Lightweight models in 39″ and 45″. 6-coil types in 46″, 55″, 65″; 8-coil in 55″ and 65″. Welded on top where it can't get dented in. Also capsule coil over 45″.

Ohio Basket Magnets 55″ and 65″ 4-coil, and 65″ 6-coil. For extra heavy-duty service; hefty ears project beyond magnet diameter, ward off damaging blows. No weight carried by bolts. Also capsule coil over 45″.

Ohio also makes
Separation Magnets,
Heavy-Duty Electric Hoists,
Nail Making Machines,
Fractional Horsepower,
Shell and Torque Motors,
Precision Threaded Parts for
Aircraft Engine Manufacturers.

THE OHIO ELECTRIC MFG. CO.
5400 Dunham Rd., Maple Heights • Cleveland, Ohio

ohio ELECTRIC

Chester Bland
President

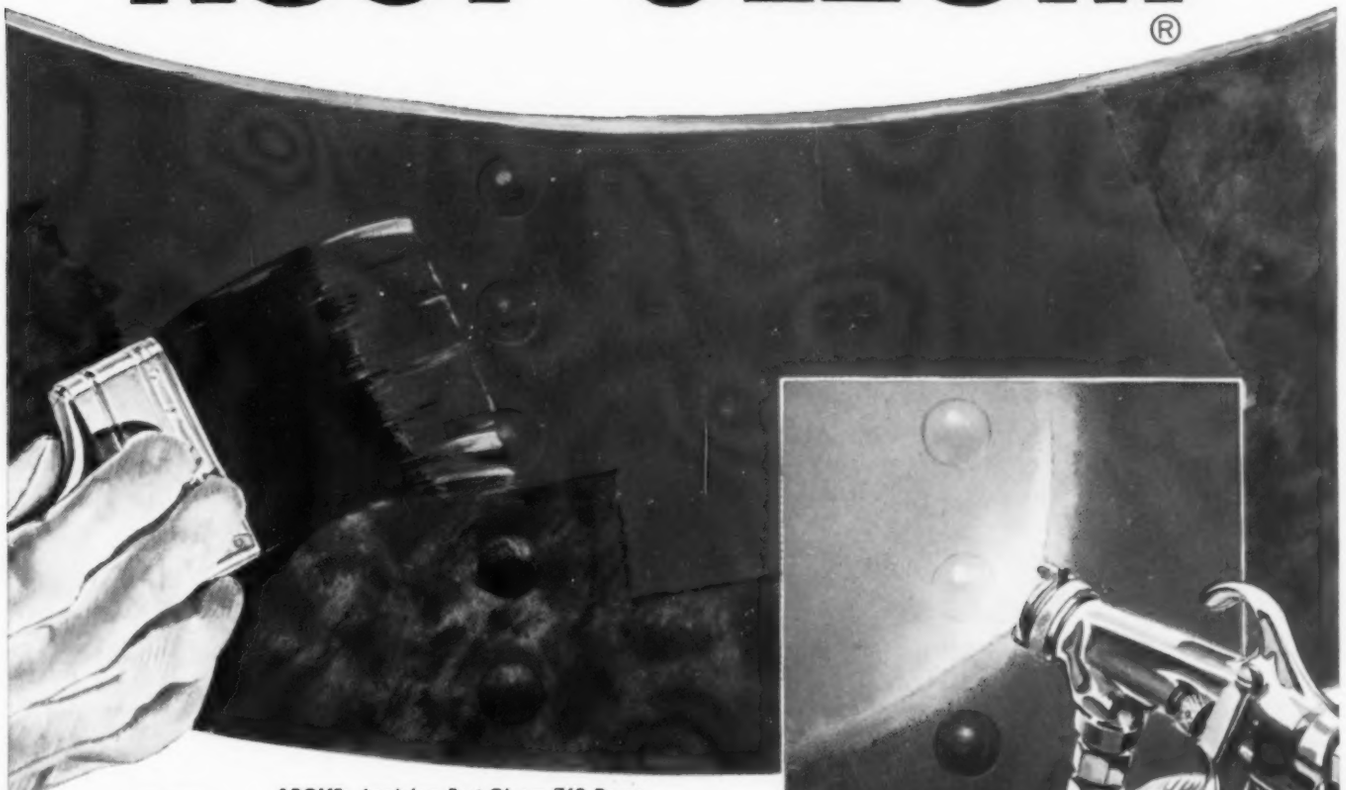
STOP RUST!

with

RUST-OLEUM®

Beautify As You Protect

Simply brush Rust-Oleum 769 Damp-Proof Red Primer directly over the rusted surface after scraping and wire-brushing to remove rust scale and loose rust. Rust-Oleum's specially-processed fish oil vehicle penetrates rust to bare metal—saving time, money, and metal! Then—beautify as you protect with Rust-Oleum's brilliant array of finish coatings. Specify Rust-Oleum for new construction, maintenance, and re-modeling. See Sweet's for complete catalog and nearest Rust-Oleum Industrial Distributor, or clip coupon to your letterhead . . . and mail today.



ABOVE: Applying Rust-Oleum 769 Damp-Proof Red Primer Over Rusted Surface After Scraping and Wire-Brushing to Remove Rust Scale and Loose Rust.

AT RIGHT: Applying Rust-Oleum Gray (One of Many Rust-Oleum Colors for Rust Prevention and Decorative Beauty).

There is only one Rust-Oleum. It is distinctive as your own fingerprint.

See local classified telephone directory under Rust Preventives or Paints for nearest Rust-Oleum Industrial Distributor.

ATTACH TO YOUR BUSINESS LETTERHEAD AND MAIL TO:
Rust-Oleum Corporation, 2443 Oakton St., Evanston, Ill.

- ☐ Please Show Me the Rust-Oleum "Rusted Panel Demonstration."
- ☐ Test Application of Rust-Oleum Over Rusted Metal Surfaces in My Plant.
- ☐ Complete Literature with Color Chart.
- ☐ Nearest Rust-Oleum Industrial Distributor.

F&Ym CONTINUOUS STRIP PICKLING LINE

NEW • EFFICIENT • ECONOMICAL

High Speed Pickling with Minimum Acid Consumption

Complete line equipment with latest improved operating features. Maximum volume production with minimum floor space requirements.

If you are interested in a new installation or improving your present equipment why not investigate the Youngstown line!

these features

- ☐ Cone Type Payoff with Strip Opener
- ☐ Triple Processor with Roller Leveller.
- ☐ Flash Welding and Mechanical Stitching.
- ☐ Pull Through Type, Triple Scale Breaker.
- ☐ Single Cycle Up-Cut Shears.
- ☐ Heavy Duty Rubber Covered, Brick Lined Steel Tanks.
- ☐ Magnetic Loop Control for Acid Tanks.
- ☐ Fume Exhaust System — Roto Clone Scrubber.
- ☐ Automatic Control of Temperature and Acid Proportioning.
- ☐ Side Trimmer with Scrap Cutting or Balling.
- ☐ Up-Coiler with Strip Oiling System.
- ☐ Entry and Exit Coil Conveyors.

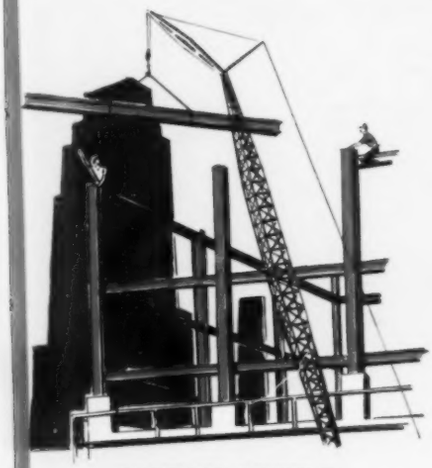
The Youngstown Foundry & Machine Co. F&Ym

SERVING INDUSTRY SINCE 1885

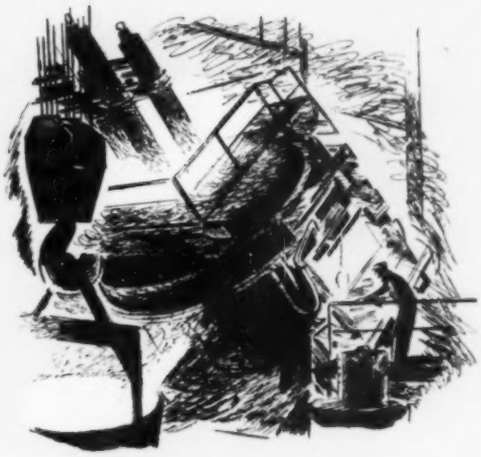
Youngstown, Ohio

NATIONAL CARBON COMPANY'S

CARBON AND GRAPHITE NEWS

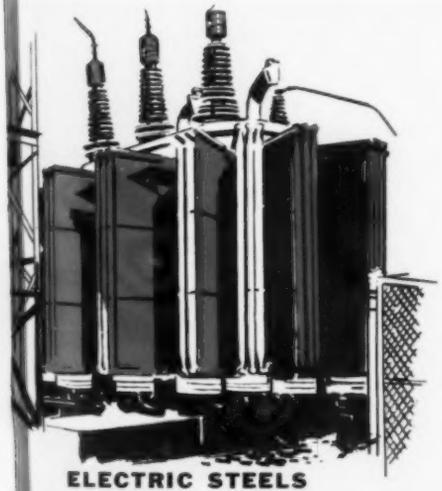


CARBON STEELS

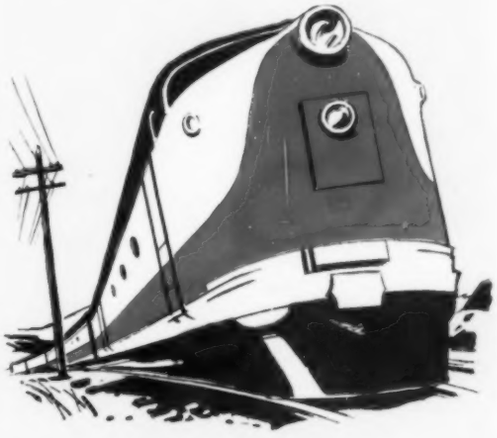


ELECTRIC ARC FURNACE

ALLOY STEELS



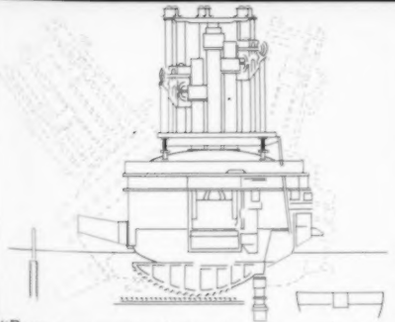
ELECTRIC STEELS



BEARING STEELS

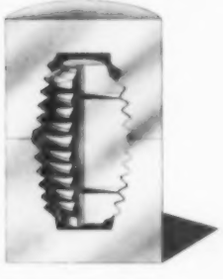
STAINLESS STEELS

IN THIS ISSUE



"FLEXIBILITY" of the electric arc furnace – defined . . . analyzed . . . what it means to the steel producer – subject of our feature article by . . .

EDWARD A. HANFF, active since 1917 in design, development and application of arc furnaces—a recognized authority in steel producing and foundry industries.



PROPERLY made electrode joints stay tight with this new Pitch-Reservoir nipple, designed to prevent collar- and nipple-loss at the arc-end of furnace electrodes.

CARBON AND GRAPHITE NEWS
MARCH, 1955—Vol. 2, No 1.

"An important advantage of electric furnace steelmaking lies in the greater flexibility of the arc furnace. . . . . ."

This statement is taken from the technical and economic study prepared by Battelle Memorial Institute* and published in July 1953. As comprehensive and complete as this study was, there are, of course, a number of factors of this kind which could not be fully discussed within the scope of Battelle's assignment.

In alignment with our expressed policy of dealing more completely and in more specific terms with various aspects of the electric furnace, our Guest Author has defined in some detail the term "flexibility" as applied to the electric furnace, and has "spelled out" its importance in steel making. The feature article, FLEXIBILITY OF THE ELECTRIC ARC FURNACE — WHAT IT MEANS TO THE STEEL PRODUCER, by E. A. Hanff, contains an accumulation of knowledge acquired from many years of association with the steel industry and experience in equipment building.

We are always glad to receive your comments on CARBON AND GRAPHITE NEWS. They enable us to keep this publication closely attuned to your interests.

PRESIDENT

*Comparative Economics of Open-Hearth and Electric Furnaces for Production of Low-Carbon Steel, a technical and economic study sponsored at Battelle Memorial Institute by Bituminous Coal Research, Inc., and fourteen electric utility companies.

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FLEXIBILITY OF THE ELECTRIC ARC FURNACE— WHAT IT MEANS TO THE STEEL PRODUCER

By E. A. HANFF

DISCUSSIONS and analyses of the electric arc furnace invariably make some reference to its flexibility, but definitions of this attribute are lacking, possibly because it lends itself to many interpretations and can encompass practically every phase of electric furnace shop operation. This is in contrast to the more easily defined advantages of the electric furnace, such as: high thermal efficiency, close quality control, low capital investment, high rate of production, compactness, reduced down-time, low maintenance and labor cost, and so on.

What Is Flexibility

The dictionary defines FLEXIBILITY as *that which is responsive to, or readily adjustable to meet requirements; susceptible to modification or variation; manageable and adaptable.*

The purpose here is to examine, within the framework of this definition, the many ways in which flexibility of design and operation of the electric arc furnace satisfies the changing requirements of the steel industry.

Flexibility to Meet Changing Business Conditions

Of real interest and concern to steel producers today is the necessity to adapt their operations to meet changing market demands, changing work-week and work-day schedules and, at the same time, to avoid the adverse influence of varying availability and quality of raw material supplies and fuels. These are only some of the more obvious factors. The flexibility of the electric arc furnace meets these conditions in many ways.

The short melting and refining cycle of the arc furnace lends itself to any practical shift and work-day schedule, with the ability to change, almost at a moment's notice, to a different schedule. Since long and costly preparations for starting up are unnecessary, one or all of the arc furnaces in the shop can be put on the line with a minimum of expense. No serious thought need be given to keeping the furnace hot between heats, as must be done with most other melting furnaces.

Flexibility in operation allows the shop to produce on three shifts or on only one shift, if desirable; or only during off-peak, low-cost electric current-load periods at an economic advantage. Large ingot production shops are thus in a position to shift over partially or entirely to custom production of practically any product analysis, in any quantity, and at any time.

The average arc furnace can be overloaded to 130 per cent of normal capacity as normal practice, or it can tap a special heat of only 30 per cent of its rated charge and still be able to slag-off the undersized heat. There are instances of arc furnaces being overloaded as much as 100 per cent to meet critical demands. This is of particular importance in the production of special castings for which large melting equipment is not justified because of intermittent demand.

When competition is most acute, the buyer expects and demands quick delivery of product because he carries less inventory and is in a position to be critical of types and quality of material. Steel producers are in a good position to meet these conditions with the electric furnace by changing compositions, quantities and operating shifts at will and with economy.

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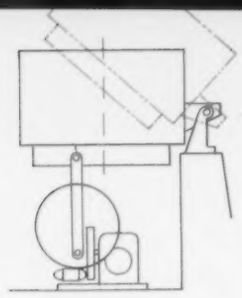
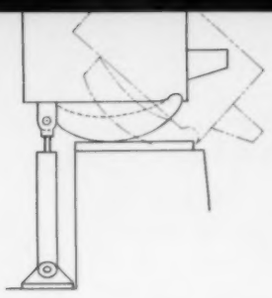


Nose Tilt
Crank Operation



Bottom Rocker
Hydraulic Operation

By virtue of its flexibility in size, needed electric furnace capacity can be installed in units or multiples of units from under two tons up to two hundred tons. This fact, coupled with its inherent flexibility of starting and shutting down at will, provides a versatile production melting unit. Though the trend is toward larger units, the specialty shops continue to operate the smaller units to considerable advantage where small heats of special analysis are required, or for making small castings where small heats of steel with high pouring temperatures are needed. Generally, the wider the range of furnace sizes available in a shop, the greater the overall flexibility of work scheduling and consequent production efficiency.

A discussion of plant operation and expansion quite logically leads to consideration of:

Flexibility in Types of Product

It is now well established that, regardless of analysis, steels of the highest quality and superior mechanical properties are produced in the electric arc furnace, largely because of the ease of controlling slag-metal reactions and bath temperatures. The arc furnace is used to melt and refine iron, produce common steels, and the entire family of high quality stainless steels. Whether the product be common low-carbon steel, low-chrome hardening steel, aircraft quality steel, high-carbon bearing steel, electrical steel, high-speed tool steel, permanent magnet steel, cobalt-base heat-resistant metals, or any of the many other high-and-low-alloy grades, the closest metallurgical control of reactions, the transformation of elements, and the maintenance of temperature are demanded. These are easily-met requirements for the electric furnace.

The arc furnace can utilize oxidizable alloying elements much more efficiently, and permits recovery of oxidizable elements from the scrap because of flexibility in the oxidizing and reducing periods of the heat. Operating control, both metallurgical and thermal, is much closer, with the result that, in basic practice, the sulphur content may be readily reduced to very low levels without difficulty. There is no contamination of the bath because the "fuel"—electricity—contains no sulphur or other impurities. This latter condition is of particular importance in assuring the uniformly high quality of all electric arc furnace products.

Flexibility in the Utilization of Scrap

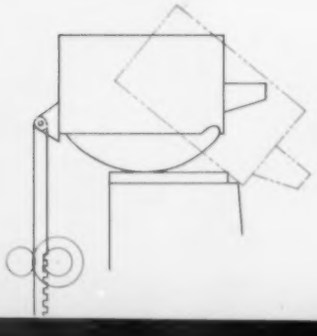
Fluctuating scrap prices point up the importance of flexibility in the types and qualities of materials that can be charged in an electric furnace. The modern top-charge type of furnace operates efficiently on a variety of types and sizes of scrap, ranging from steel turnings and iron borings to crop ends, skulls, heavy melting-scrap bundles and scrap ingots. Even unbound materials can be charged at a considerable saving in scrap cost. Thus the ability to consume most types of scrap without regard to size, weight or density, places the arc furnace steel maker in an enviable position from the standpoint of cost of metallics.

Flexibility in Slagging Practice

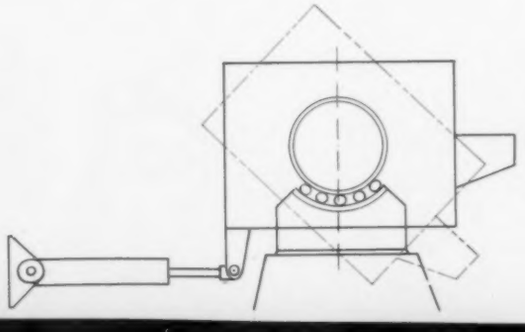
Slag composites used in the arc furnace can be controlled with much greater ease than in other conventional melting processes. The tilting mechanism makes slagging-off a simple operation. This permits the easy establishment of oxidizing, reducing or neutral slags, or any combination or succession of such slags. It also is well known that the arc furnace requires much less slag than other melting furnaces—meaning, of course, there is less slag-material cost, less heat loss, and less metal loss; there also are less slag-making materials to add, handle and dispose of.

Flexibility in the Foundry

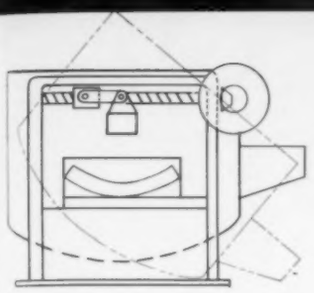
In addition to the broad variety of materials produced in the steel mill, the electric arc furnace is a most flexible unit in the steel foundry. Besides



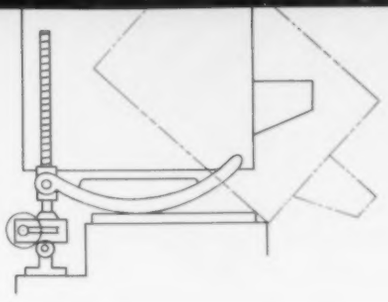
Bottom Rocker
Rack and Pinion
Operation



Side Roller Trunnion
Hydraulic or Screw
Operation



**Side Rocker
Horizontal Screw and Nut
Operation**



**Bottom Rocker
Vertical Screw and Nut
Operation**

its basic use for melting metals, the same type of furnace is used for off-setting heat losses in foundry duplexing, and as a super-heating furnace to raise the temperature of iron melted in the cupola for pouring large numbers of small castings. It also is used economically to hold steel from a converter when more than one heat is required for pouring very large castings.

Because of its flexibility in size and construction, the electric arc furnace can be located without difficulty in an existing foundry or, when building a new arc furnace foundry, its size and operating characteristics allow many economies in the construction of the buildings.

Flexibility in Design

Much the larger part of new furnace capacity is installed in existing mills and must, in design and construction features, take into account such factors as head-room, materials-handling equipment and floor plan. In this respect, the arc furnace offers flexibility of design which makes it suitable to almost any size and type of operation.

Many different tilting arrangements have been used. The great majority of furnaces now use motor driven tilting means, although hydraulic cylinders are also used where they may be preferred.

Two principal mast and electrode arm arrangements are in use, depending upon the physical limitations of the shop. The arm and crosshead move up and down as a unit in the fixed mast type, while, in some buildings, the crane head-room limitations require the use of the moving mast construction.

Several designs of tilting arrangements and electrode masts are shown in the accompanying illustrations.

Arc furnaces vary from the six-electrode, elliptical-shell type that is over 25 years old and still in operation, to the original prototype, single-electrode, bottom-contact furnace that was the forerunner of today's three-phase, three-electrode, top-charging units. Many different electrode arrangements are in use—the direct-arc, the submerged-arc, and the indirect-arc of the non-ferrous unit. Of these, the three-electrode, direct-arc type is by far the most commonly used.

Most modern arc furnaces are designed with swing-aside roof for top-charging. They may, however, be designed for side-charge by hand, chute, or machine.

Ideal planning recommends a shop designed to make full use of the flexibility and broad adaptability of the electric furnace.

Flexibility in Plant Location

The electric furnace plant can be located almost anywhere, since it is not dependent upon coal, gas, or coal-tar products for fuel. Areas having abundant electric power can be utilized. This makes possible decentralization, bringing the product much closer to the consumer market. The building of a number of smaller plants at strategic locations, rather than the single, large, centralized plant, offers many ways to reduce product cost by taking advantage of lower freight rates, lower power cost, a favorable labor market, and greater availability of raw materials. The electric furnace, being readily portable, never becomes a fixed part of the land.

Flexibility for the Future

The future of electric arc furnace steel operations can be projected only by using the past and the present as a guide—but this must never become a limitation. These things we do know:

Everyone within the steel industry favors the electric furnace over all other types for cold-melt practice, and there is increasing use of hot metal in the electric furnace. As process methods are developed in the future, duplexing and triplexing will become more prominent, using the arc furnace as the unit to absorb the remelt scrap, as well as to refine and adjust final analysis.

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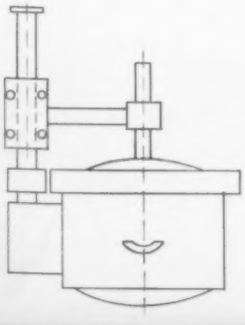
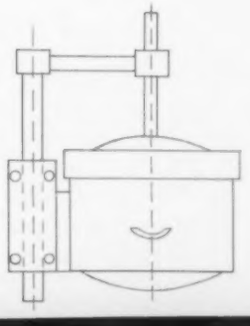


**Fixed Mast
Moving Crosshead
and Arm**



**Moving Mast
and Arm**

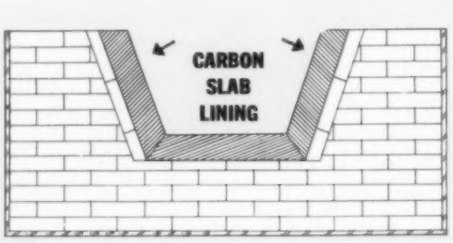
CARBON FOR RUN-OUT TROUGH LININGS

THE BROAD acceptance and rapidly increasing use of carbon and graphite in the making, working and fabrication of metals have vastly increased the industry's knowledge of the properties of these two materials.

In many cases carbon and graphite are the only materials that have been successful in meeting the severe and exacting requirements involved in handling hot metals and corrosive slags. This is due to their well-known properties, such as: they are not wetted by molten metals and thus, the metal does not stick to them; they maintain their mechanical strength well past the temperatures attained in handling molten metals and slags; they do not suffer deformation at high temperatures; their resistance to thermal shock obviates spalling and consequent inclusions or other undesirable effects of ceramics; their negligible thermal expansion assures uniformity in size and shape under all heat conditions; their light weight facilitates handling. Since these properties always have been basic requirements in metallurgical industries, carbon has become the logical choice of economical materials for a great many applications.

Blast Furnace Run-Out Troughs

Carbon in standard block shapes is in wide-spread use for run-out trough linings from the taphole to the splash plate. For lining the iron basin and runners, standard carbon brick shapes should be used. The use of large carbon blocks effects a considerable saving in the cost of installing a run-out trough lining because much less time is required to handle and place fewer pieces, while chipping and fitting are reduced to a minimum.



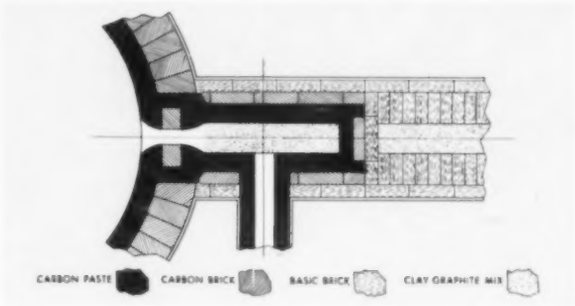
The carbon lining is built up of three-piece sections, each consisting of two side blocks and one bottom block laid into a ceramic-lined trough. Conventional cast iron or refractory constructed troughs may be lined with standard carbon bricks or slabs, with the voids between the carbon shapes and the trough filled with ceramic brick bonded with carbonaceous cement between the carbon brick and the ceramic. As a result of this construction, repairs can be made to necessary sections without replacing the whole construction.

Since iron does not stick to the carbon, iron

draining from a carbon runner is exactly like mercury draining from a glass plate. If the iron is cold and of high sulphur content, a skull forms in the runner, but it always is loose and easily removed. Oxidation can be prevented by brushing the carbon with a clay slurry before each tap. The disagreeable and costly maintenance of troughs is greatly reduced, there is no delay in tapping, and the metal is clean.

Neither does slag stick to carbon, so that the same lining practice employed for iron runners applies equally well to slag runners.

Cupola Run-Out Trough and Dam Linings



The same characteristics of carbon in the form of bricks, shapes and paste are found to be ideal for cupola run-outs and dam linings also.

In this case the practice of lining troughs and runners differs somewhat from that of the blast furnace because of the inherent differences in operation dictated by the nature of the furnaces. While these differences are less pronounced with back-slagging cupolas, the growing interest in front-slagging has presented chemical and metallurgical problems which require a different concept of linings for the slag dam and iron trough.

On basic cupola, the trough between the taphole and the slag dam is lined with rammed carbon paste, with the dam itself being constructed of a solid block of carbon, faced with a coating of carbon paste approximately 4½" thick. The run-out trough is lined with ceramic brick against the trough, then faced with carbon brick and, finally, a thick coating of carbon paste.

Carbon has proved itself a superior refractory in the front-slagging spout where it is of utmost importance to select and properly install good refractories. The refractory at the top of the dam is subjected to slag attack; while nearer the bottom, and also in the runner, it is eroded by the iron. Because the construction of the dam determines its operation, dimensions are quite critical; this means that lack of lining stability can change the dimensions sufficiently to allow air leakage through the taphole, making it necessary to reduce the air pressure or stop the operation for repairs.

Copies of CARBON AND GRAPHITE NEWS, Vol. 1, Nos. 1 and 2, are still available

Write National Carbon Company, 30 East 42nd Street, New York 17, New York, giving name, title and company address.

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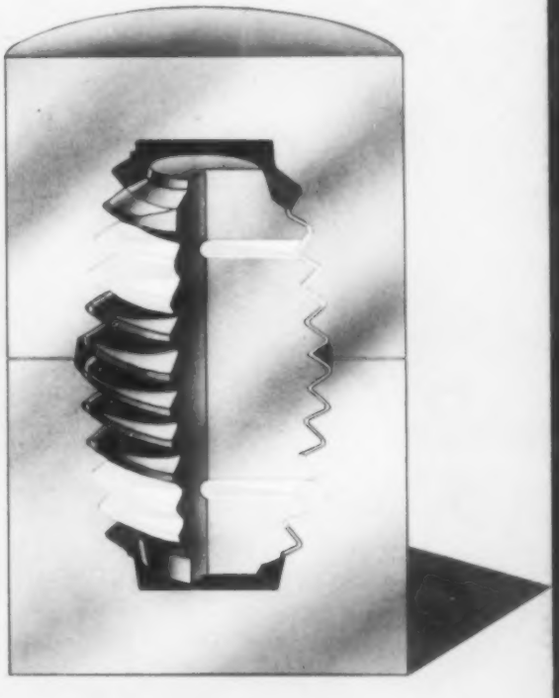
NEW PITCH-RESERVOIR* NIPPLE KEEPS ELECTRODE JOINTS TIGHT

Properly made electrode joints are kept permanently tight under normal operating conditions by National Carbon Company's exclusive new Pitch-Reservoir nipples, now available for use with graphite electrode diameters from 14-24 inches.

Identical with standard, tapered, graphite nipples in size, shape, tolerances, composition and quality, this new nipple design is distinguished by the pitch-filled reservoirs near each end of the threaded portion. As the nipple becomes hot, the pitch flows from the reservoirs into the threaded section of the joint where it cokes-out, cementing and locking the threads of the nipple and sockets together. This action occurs at temperatures well within the range of the operating column. No manual application of cement or pins is required.

Highly effective in eliminating collar- and nipple-loss at the arc-end of the electrode, "National" Pitch-Reservoir nipples have already resulted in lower electrode cost and greater furnace efficiency in a number of installations.

Detailed recommendations for proper joining procedure using the new Pitch-Reservoir nipples, Type PR-F, can be obtained by writing to CARBON AND GRAPHITE NEWS c/o National Carbon Company.



**Patents Pending*

FLEXIBILITY OF THE ELECTRIC ARC FURNACE —WHAT IT MEANS TO THE STEEL PRODUCER

(Conclusion)

The submerged-arc furnace is the key to the ever-expanding production of such products as phosphorus, calcium carbide, silicon, and the ferrous and non-ferrous alloys.

Still other new fields of arc-furnace utilization are the recovery of lead, zinc, and other metals from slags, while some steel-makers are using arc furnaces to make special slags which are added to the ladle. This last usage is the Perrine (French slag) process which has received very favorable comment.

Centrifugal casting and the continuous casting of steel owe a measure of their success to the electric arc furnace as an ever-ready reservoir of hot metal at proper temperature and analysis. Nodular iron, as applied to shell molding, is expediently made in the arc furnace by spout addition of nodularizing alloys. Of outstanding interest also is a vast array of new "specialty" alloys. All of these products are economic and metallurgical successes only because of the electric arc furnace.

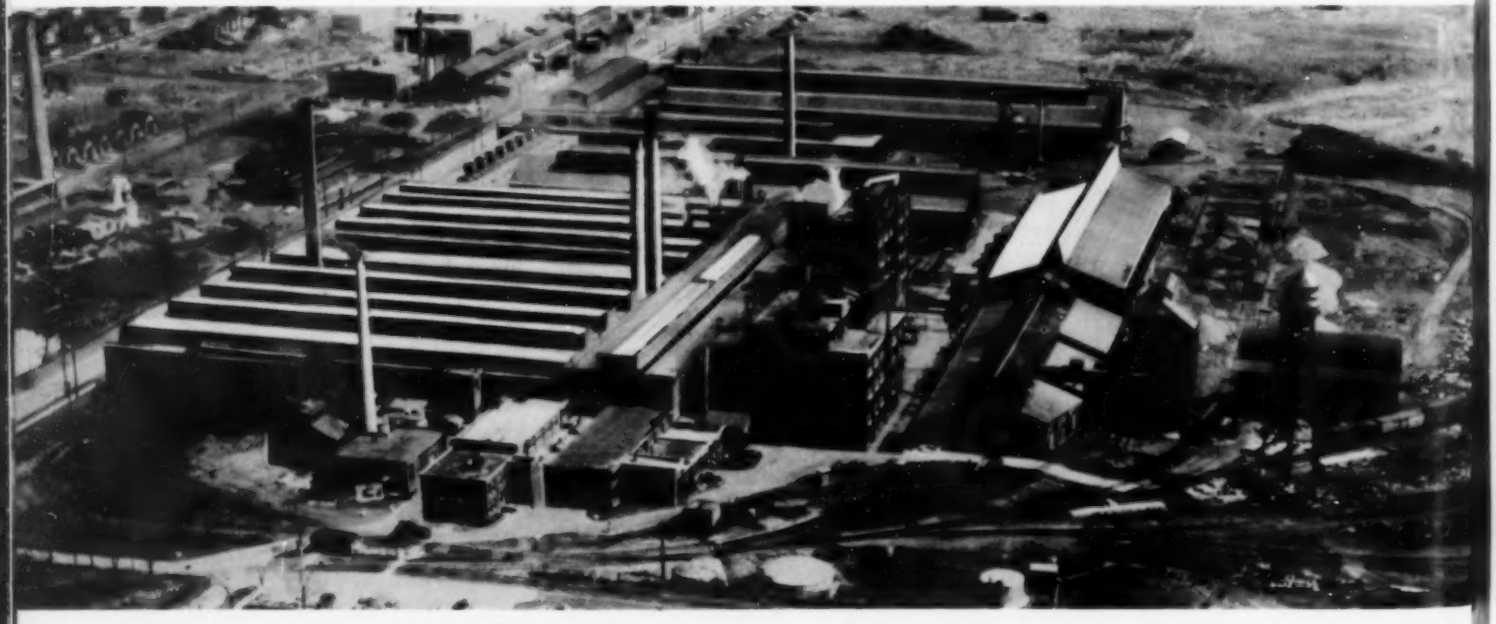
An entirely new field, that of vacuum melting, is now being explored. Melting in a vacuum, or in an atmosphere of inert gases, is an absolute necessity for oxygen-sensitive metals. Research in this field has shown that the use of this process in the production of other alloys and special steels imparts surprising and undreamed-of properties to the product. There are many problems to be solved in this development, but favorable progress is assured.

Competition is becoming keener. The effort to improve product quality and reduce its cost never has been greater than at present. Whether to expand or contract plant capacity, or alter its physical structure and facilities, requires serious decisions by management. Such decisions involve long-range forecasting, millions of dollars, and a combination of sound judgment, logic, and an unshakeable faith in the future. The electric arc furnace can play a decisive part in meeting these requirements of the future.

Summary

The electric arc furnace has been examined as a FLEXIBLE unit that is: *"readily adjustable to meet requirements; susceptible to modification or variation; manageable and adaptable."* Seven major requirements of the steel mill and steel foundry have been analyzed in terms of the electric furnace. It has been found that no other method for melting, smelting, reducing and refining metals and alloys satisfies all these closely defined needs as fully as the electric arc furnace.

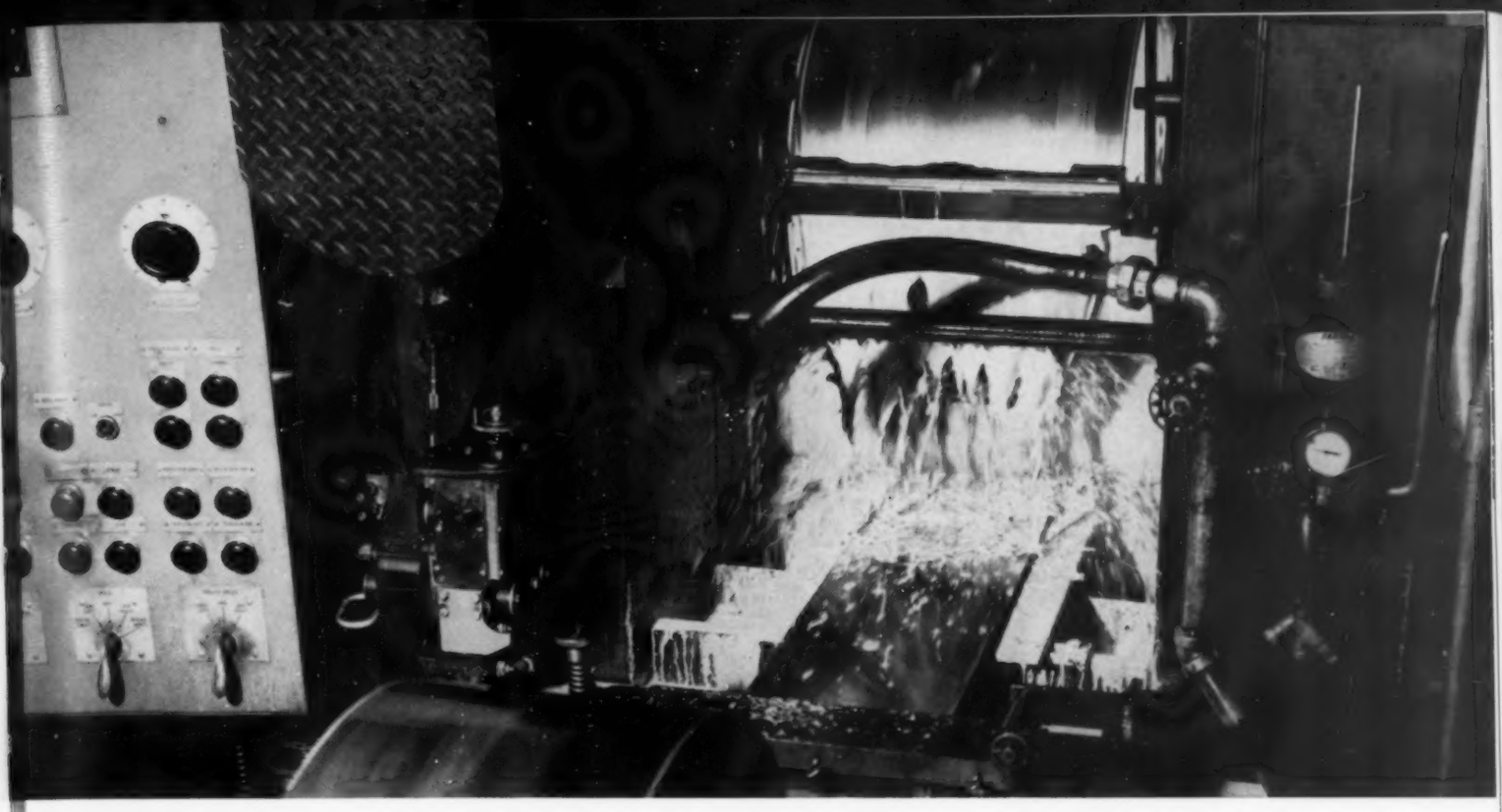
EDWARD A. HANFF *received his B.S. degree in Electrical Engineering at Worcester Polytechnic Institute in 1910. Following service as a controller engineer with Westinghouse Electric Corporation, he became associated with the early design and development of electric arc furnaces in 1917. Since that time, he continuously has been engaged in the application of industrial furnaces of various kinds and is now Vice President, Swindell-Dressler Corporation, Pittsburgh, Pennsylvania.*



NATIONAL Plant, Niagara Works of National Carbon Company
A Division of Union Carbide and Carbon Corporation

Third in the series featuring the five plants of the company that are devoted to the manufacture of carbon and graphite electrodes, *National* Plant, shown here, is but one of three plants located in Niagara Falls, New York. The other two are *Acheson* and *Republic* Plants.

The manufacture of electrodes at the Niagara Works is greatly enhanced by the close integration of the three plants. *Republic* is a baking and finishing plant. *National* Plant forms, bakes and machines coal electrodes, while the *Acheson* Plant does all graphitizing and machining of graphite electrodes.



NEW SUNOCO EMULSIFYING ROLLING OIL EASIER TO USE, LASTS LONGER

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- Adequate Ventilation
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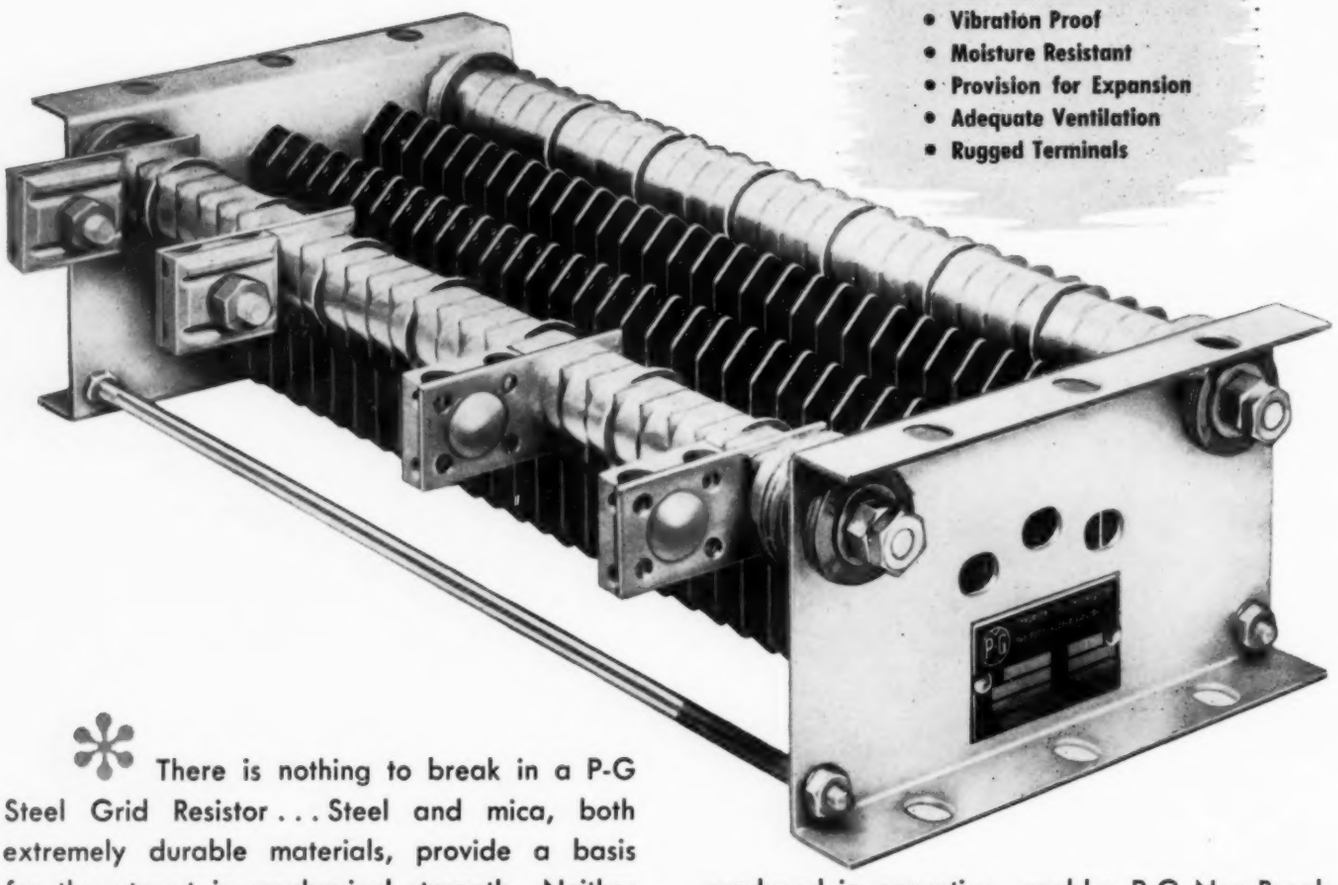

There is nothing to break in a P-G Steel Grid Resistor . . . Steel and mica, both extremely durable materials, provide a basis for the utmost in mechanical strength. Neither do vibration, nor moisture laden or corrosive atmospheres have material effect on P-G Resistors . . . This, together with provision for expansion as well as efficiency in dissipating heat produced in operation, enables P-G Non-Breakable Resistors to give long and trouble-free service . . . The next time that troublesome application is at hand, specify P-G and solve your maintenance problem.

P-G has BOTH! STANDARD Resistors — WELDED Resistors

P-G

The Nonbreakable Steel Grid Resistor

THE POST-GLOVER ELECTRIC COMPANY

• ESTABLISHED 1890 •

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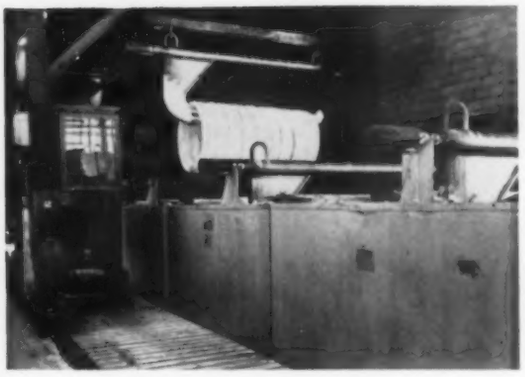
NO PICKLING PROBLEM Too Large or Too Small

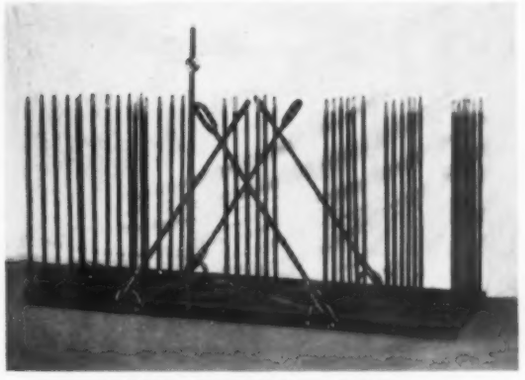
WELDCO Specialists Handle Them All!

IN HUNDREDS OF PLANTS, you'll find Weldco equipment all along the pickling line. For Weldco products are made of corrosion-resisting, hot rolled metals, that withstand attack from hot acids and other pickling solutions. They are strong yet light-weight, wear-resistant, durable, and long-lasting. You get all these advantages when you specify Weldco hooks, mechanical picklers, crates, baskets, racks, chain, steam jets, and accessories.

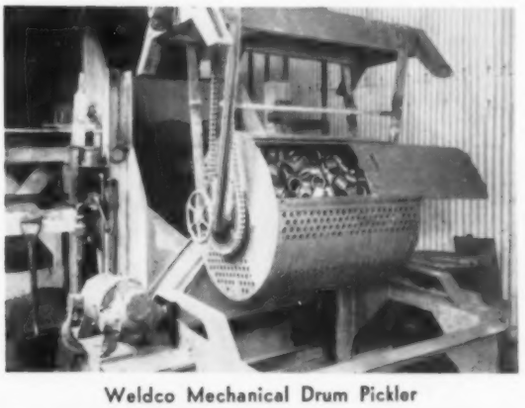
Weldco offers a complete, well-designed line of pickling equipment . . . plus the services of our experienced staff. Let Weldco engineers take care of all your pickling needs. For any problem, large or small, they have the practical, cost-cutting answer.



Weldco Pickling Hooks

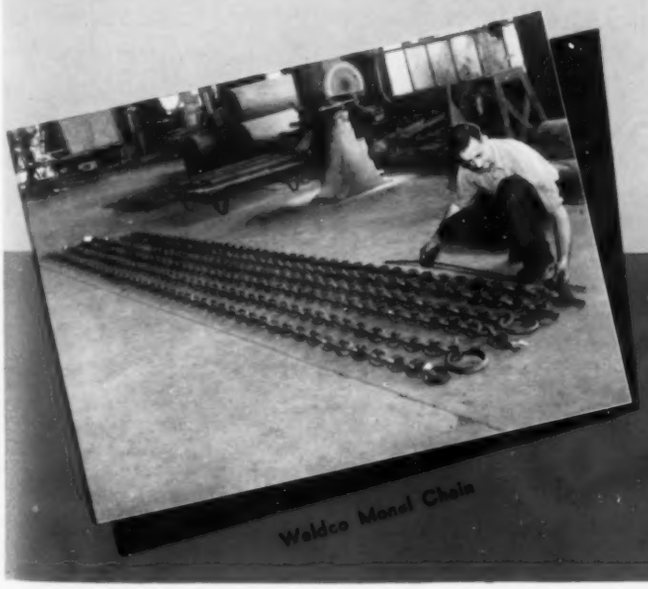


Weldco Sheet Pickling Crate



Weldco Mechanical Drum Pickler

Weldco Mechanical Bar and Tube Pickler

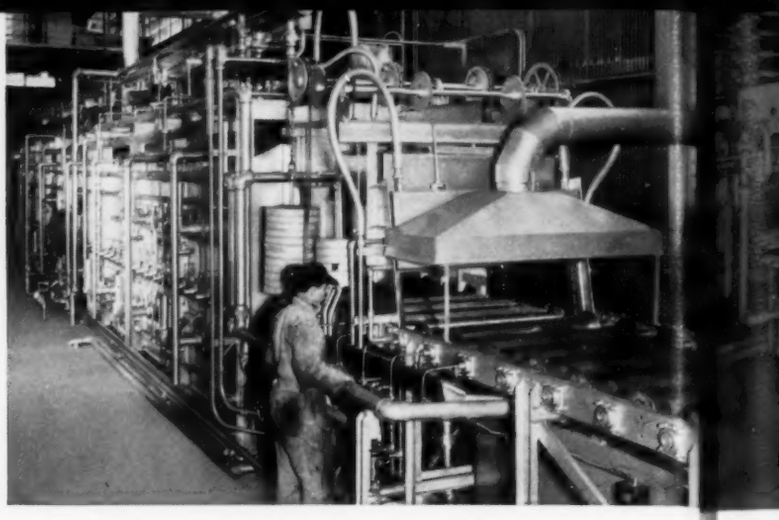


Weldco Monel Chain

THE YOUNGSTOWN WELDING & ENGINEERING COMPANY

3712 OAKWOOD AVE. · YOUNGSTOWN 9, OHIO

continuous processing



'Surface' roller hearth furnace for continuous carbon restoration-annealing of bars and coils.

'Surface' atmosphere equipment

'Surface' lift cover car bottom furnace used for batch carbon restoration-annealing of bar stock.

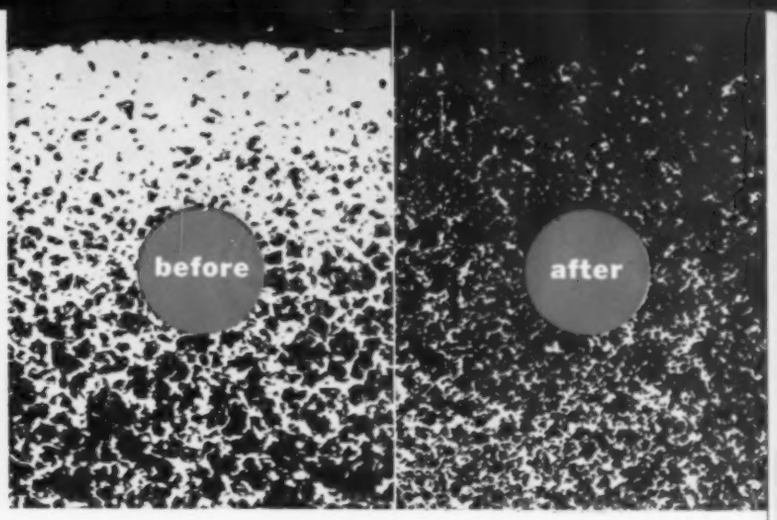
batch processing

Here are a couple of graphic reminders that Surface Combustion atmosphere equipment helps meet today's demands for top quality steel.

These cases repeat a familiar story in the steel industry: a steel processor wants to improve the metallurgical qualities of his stock—'Surface' equipment meets, and frequently exceeds, his specifications.

In your current program for improving the marketability of your products, look to 'Surface' to provide the right atmosphere for easier sales.

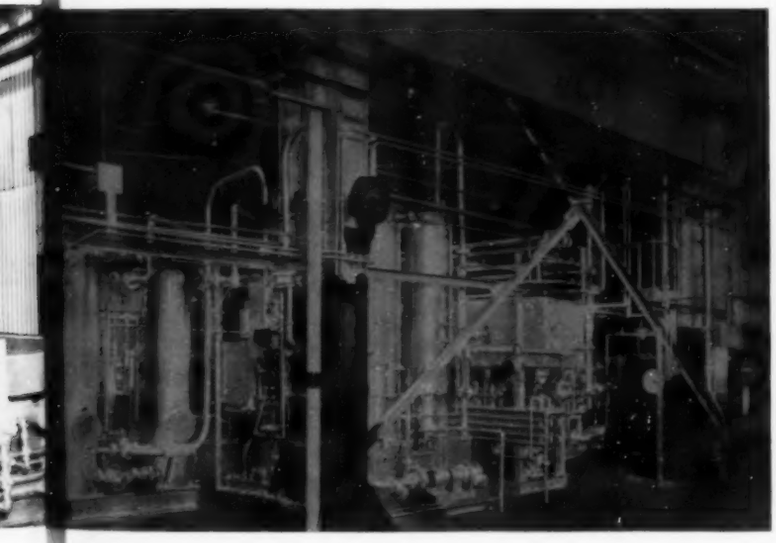
'Surface' atmosphere generators for this installation. RX unit in the foreground, NX unit in the background.



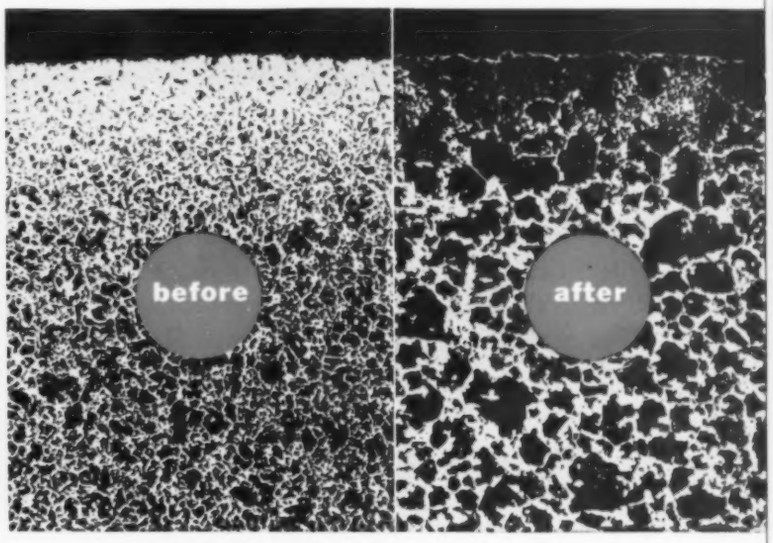
Before and after photomicrographs, Carbon steel AISI C1050. The results: carbon restored to the decarburized skin; steel which reduces the customer's machining costs, eliminates rejects.

makes steel easier to sell

'Surface' atmosphere generators next to the furnace. NX generators and coolers in the foreground, RX generator and dew point recorder in the background.



Before and after photomicrographs, C-1045, 1 1/16" round, coarse grain, 75x, 4% Nital etch. The results: carbon restored to the decarburized skin; steel that sells and opens new markets for the processor.



Surface
STEEL MILL FURNACES

SURFACE COMBUSTION CORPORATION · TOLEDO 1, OHIO

Four Ajax Floating Shaft Dihedral Couplings solve angular drive problems on tilting tables for the Green River Steel Corp., Owensboro, Kentucky.

AJAX

FLOATING SHAFT DIHEDRAL *Couplings*

Driving Manipulator Rack for 24" Bar Mill Tilting Table

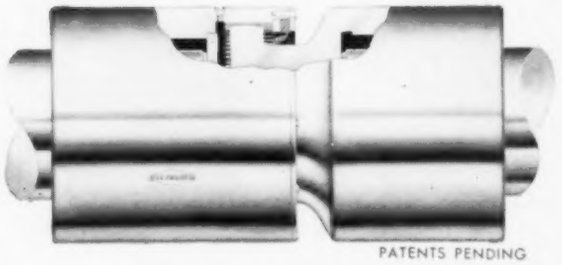
● Design and installation conditions required couplings with 6 degree angular offset to drive the manipulator racks on these Birdsboro tilting tables built for the Green River Steel Company, Owensboro, Kentucky.

Four Ajax Dihedral Couplings with floating shafts 8' 9¾" long between centers each handle 15 h. p. at 55 RPM.

These manipulators are used to turn a bar and move it to the next pass in a 24" three-high mill. Tables and manipulator are shown at shop assembly.

These Ajax Dihedral Couplings have proven their ability to handle heavy loads under continuous operation. Service has been constant and the only maintenance is for occasional lubrication. Exclusive Ajax Dihedral design results in maximum misalignment capacity with tooth clearance limited to lubrication film requirements.

Write for complete information.



PATENTS PENDING

ALSO AJAX DIHEDRAL SPINDLE SHAFT COUPLINGS

The performance of Ajax Dihedral Spindle Shaft Couplings is the talk of the steel industry. In the words of hard boiled mill operators, "They have made conventional roll drives obsolete".

Constant peripheral speed results in smoother finish sheet, increased roll speed and longer time between roll grinds.

Design permits quick roll changing.

Write for Bulletin 58 just off the presses.

AJAX FLEXIBLE COUPLING CO. INC.

WESTFIELD, N. Y.

REPRESENTATIVES IN PRINCIPAL CITIES

Newest idea in seamless tube production

Looking for improved methods of tube and pipe making?

Applying the three-roll arrangement for high speed continuous tube and pipe rolling mills is only one of our recent firsts in mill design.

Bringing new developments to bear on your tube mill problems is second nature for Mannesmann-Meer. Nowhere else is the combination of

- CREATIVE ENGINEERING
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available and ready to go to work for you. Call on Mannesmann-Meer Engineering & Construction Company, 900 Line Street, Easton, Penna. M-44

MANNESMANN-MEER

World Specialists in High-Speed Tube Mill Machinery

ELLIOTT CROCKER-WHEELER 600 SERIES MILL MOTORS

This is one of three 450-ton hot metal ladle cranes servicing nine furnaces in the open hearth department of U. S. Steel's Fairless Works. They were designed and built by the Alliance Machine Company of Alliance, Ohio and are the largest cranes ever built for this type of operation.

The various hoist, trolley and bridge motions of these mechanical giants demand rugged, dependable motors that can stand the gaff of peak loads and heavy current changes. Elliott C-W 600 series mill motors have proven a natural for the job. Each crane employs eight of these motors, totalling nearly 1300 hp. They range in size from the two 265-hp motors lifting the 450-ton main hoist (through a synchronized worm gear), to a 65-hp motor operating the second auxiliary hoist.

For complete details on these motors, call your local Elliott field engineer, or write for the Mill Motor Bulletin to Elliott Company, Jeannette, Pa.

ELLIOTT Company

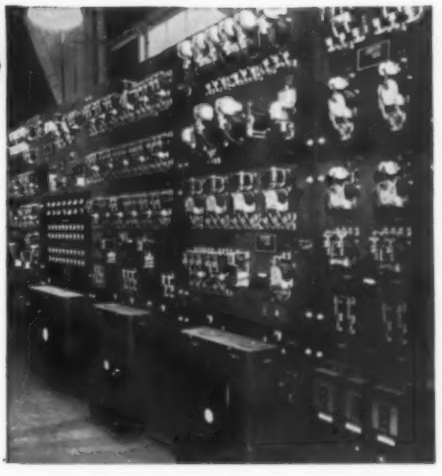
W4-6

TURBINE-GENERATORS TURBINES MOTORS GENERATORS DEAERATING HEATERS EJECTORS CONDENSERS COMPRESSORS TURBOCHARGERS TUBE CLEANERS STRAINERS

CLARK CONTROL at KAISER-FONTANA

Typical of the accuracy and dependability required of electrical controls in industrial automation are the Freyn Design, Clark-built blast furnace charging control systems installed for the 3 huge blast furnaces at the Fontana, California plant of Kaiser Steel Corporation.

Shut-downs at blast furnaces are costly. Proper sequence charging and distribution of coke, ore and limestone are vital to their continuous operation. Koppers-Freyn Engineers, leading designers of blast furnace charging controls, specified Clark-apparatus to keep these furnaces going 24 hours per day.



Clark engineered controls are the "mechanical brains" for countless automatic machines and processing lines in all types of industry. Clark engineers will gladly show you how best to solve your control problems.

Clark Control Panel for Freyn Design blast furnace charging control at the Kaiser-Fontana plant.

The **CLARK CONTROLLER** *Company*

Engineered Electrical Control

1146 East 152nd Street • • Cleveland 10, Ohio

Cleveland Cranes
FOR
STEEL MILL SERVICE
10 TON
CLEVELAND CRANE
CLEVELAND CRANES
MODERN ALL-WELDED STEEL MILL CRANES
5031 EAST 289th ST.
WICKLIFFE, OHIO

Crops *and* Shorts

SHIPMENTS of finished steel products in 1954 totaled 63,152,726 net tons, seventh highest in the history of the industry. Figures released by the American Iron and Steel Institute show sheet and strip shipments at 21,778,753 tons, pipe and tubing at 8,157,736 tons, tin mill products at 5,660,366 tons, heavy structural shapes at 4,501,183 tons, and wire and wire products at 3,472,376 tons. The largest market classifications, in order, were warehouses, automotive, construction, containers and makers of machinery and tools.

▲

AN organization, called the National Right to Work Committee, has been formed "to establish in the United States the principle that Americans must have the right, but not be compelled, to join labor unions." President of the group is Fred A. Hartley, Jr., of Taft-Hartley fame. The organization plans to sell its ideas by means of a national educational and information program.

▲

OCCASIONALLY you hear a group of men complaining about the high price of current automobiles, and almost invariably, they will agree that the plethora of accessories and extras is responsible. Yet, if the extras are taken one by one, each one will find hearty supporters who think it is a fine feature to have on a car. And so we approach the necessity of adding two more wheels to the cars to carry the trimmings.

This same reluctance to do without unessential trimmings pervades all phases of today's living and seems particularly prevalent in the political field. Government on all levels has accumulated parasitic appendages which soak up tax money at an appalling rate while delivering inconsequential services which could well be abolished. The pork barrel seems to be filled with filet mignon nowadays.

Federal, state and local taxes in 1954 totaled about $90,500,000,000, more than 30 per cent of the national income. In 1929, it was less than 12 per cent. The federal government collects about 75 per cent of the total taxes, leaving only 25 per cent for state and local governments as against their 66 per cent in 1929.

This is a serious condition and obviously calls for reduced expenditures and realistic choices in spending. It is imperative that governing bodies trim out unessential and secondary activities, and that taxing bodies give up some of their gravy, hurt though it may. Let's do without the unessential trimmings that we can't afford.

▲

AND the trouble with the government spending more than comes in is that wives begin to think it's all right to do so, too.

▲

IN case you're marveling over the new improvements on automobiles, you should know that the first known application of power steering was covered by patent No. 175,601, issued to G. W. Fitts in 1876.

▲

THE iron and steel industry experienced the lowest accident rate in its history during 1954. The record, per million man-hours worked, shows a frequency rate of 3.85 lost-time accidents and a severity of 0.87 days for 1954, as compared with 4.75 frequency and 1.08 severity in 1953.

▲

WE haven't actually checked, but we've been told that the 1948 platforms of both Republican and Democratic parties were almost literal echoes of the 1924 platform of the Socialist party. What might the next 30 years bring?

▲

ACCORDING to the American Iron and Steel Institute, the average hourly payroll of wage earners in the industry set a record in 1954 at $2.333. If the costs of pensions, social security and insurance are included, this figure becomes $2.51, against $2.44 for 1953.

The industry's total payroll for 1954 is estimated at $2,908,339,000, with an average total employment of 611,000 individuals. Wage earners worked an average of 36.1 hours per week.

▲

INCOME tax reports may, as is claimed, show a lot of mistakes, but they also show an awful lot of takes.

▲

A trust fund to finance social, educational and recreational activities in surrounding communities has been set up by Great Lakes Steel Corp. and Local 1299 of the United Steel Workers of America, which represents Great Lakes workers. The company contributed an initial $25,000 and will add a similar amount during the year at the rate of $3 for each dollar given by the union.

▲

ACCIDENTS sustained by Americans while mowing their lawns have moved the Lawn Mower Institute to request a standard safety code for mowers. Power mowers have, of course, aggravated the situation.

Our own personal safety practice is to let someone mow the lawn for us.

▲

BITUMINOUS coal production, which totaled 392,000,000 tons in 1954, is expected to increase by five or possibly ten per cent in 1955.

HAGAN CONTROL produces exact delivery of blast furnace air at Pittsburgh Coke & Chemical

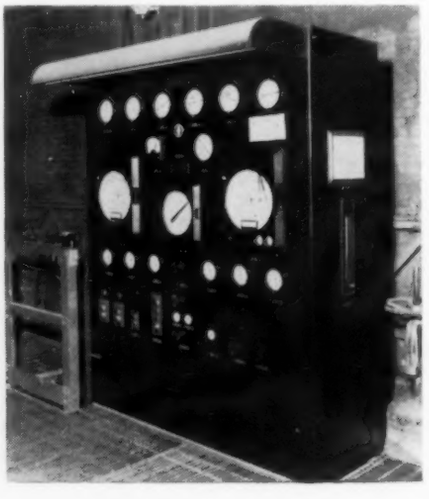
The Hagan Blast Furnace Blower Control System at the Pittsburgh Coke & Chemical Company plant regulates an Elliott Company steam turbine driving an Elliott centrifugal blower. The complete Hagan pneumatic control system includes an air flow meter, steam flow meter, turbine governor control and the control panel. The system has been in successful operation for the past two years.

The Hagan Blast Furnace Blower Control System automatically compensates for temperature and barometric pressure changes, and delivers air to the furnace on a standard cubic feet per minute basis regardless of variations.

The Hagan Ring Balance Air Flow Meter permits the use of low head venturis or orifices with resultant low permanent pressure loss, leading to substantial power savings. This fully automatic, compensated system eliminates periodic manual adjustment, reducing operator work load.

Write for Bulletin MSA 114A, which describes in detail this precision control system. The Hagan Blast Furnace Blower Control System can lower operating costs of both new and existing installations.

Left: Elliott Turbine and Blower in foreground—Panel at rear. Right: Panel board mounts all instruments to give complete picture of blower operation—records steam flow to turbine, air flow to furnace in scfm, speed, pressure and temperature gauges, manual flow rate set point and indicator.



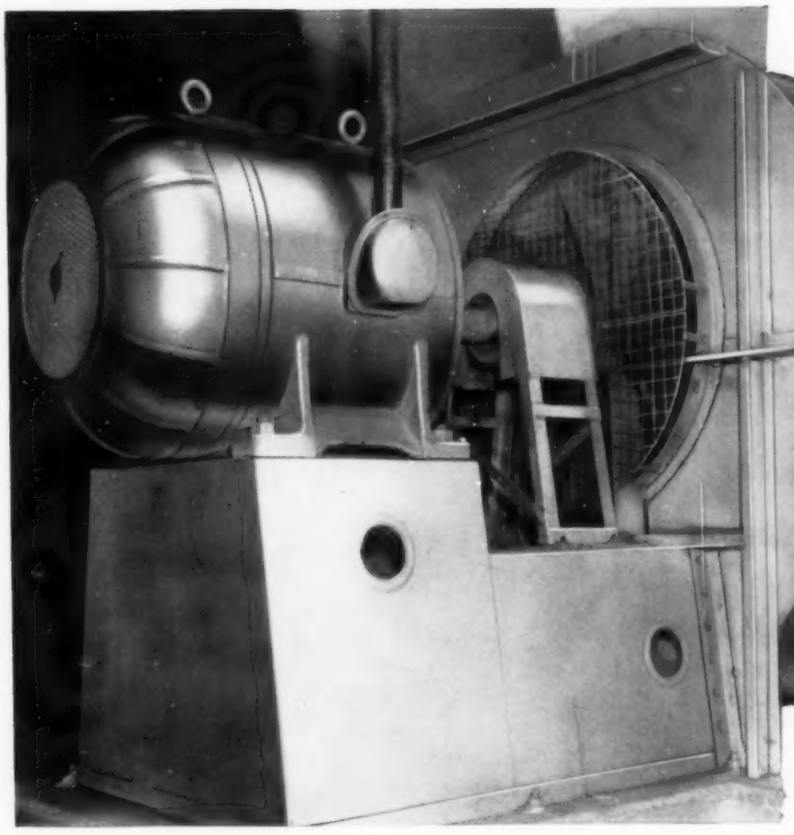
HAGAN HALL BUROMIN CALGON

HAGAN CORPORATION

Hagan Building • Pittsburgh 30, Pennsylvania

Boiler Combustion Control Systems • Ring Balance Flow and Pressure Instruments • Metallurgical Furnace Control Systems • Control Systems for Automotive and Aeronautical Testing Facilities

RIGHT FOR THE SEVERE MILL MOTOR COOLING JOB!



"Buffalo"

MILL MOTOR FAN

Mill motor cooling calls for fans able to take heat, pressure and continuous service — and we build these fans accordingly. The heavy steel plate housing, the strong, rigid wheel with massive hub, heavy-gauge back plate, flange and die-formed blades — are part of the "Q" Factor* that goes into these "Buffalo" Fans.

For the best answer to your mill motor cooling problem, call on your nearby "Buffalo" representative. A Graduate Engineer, trained in our factory and in the field, he's ready and competent to cooperate with your own engineers or contractors in any air handling application.

- Built to stand heat and develop high pressures
- Cannot be overloaded
- Heavy construction — to **stay** on the job
- Desirable performance characteristics
- High in efficiency — backward curved blades and inlet guide vanes

*The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.

"Buffalo"

BUFFALO FORGE COMPANY

173 MORTIMER STREET BUFFALO, N. Y.

PUBLISHERS OF "FAN ENGINEERING" HANDBOOK

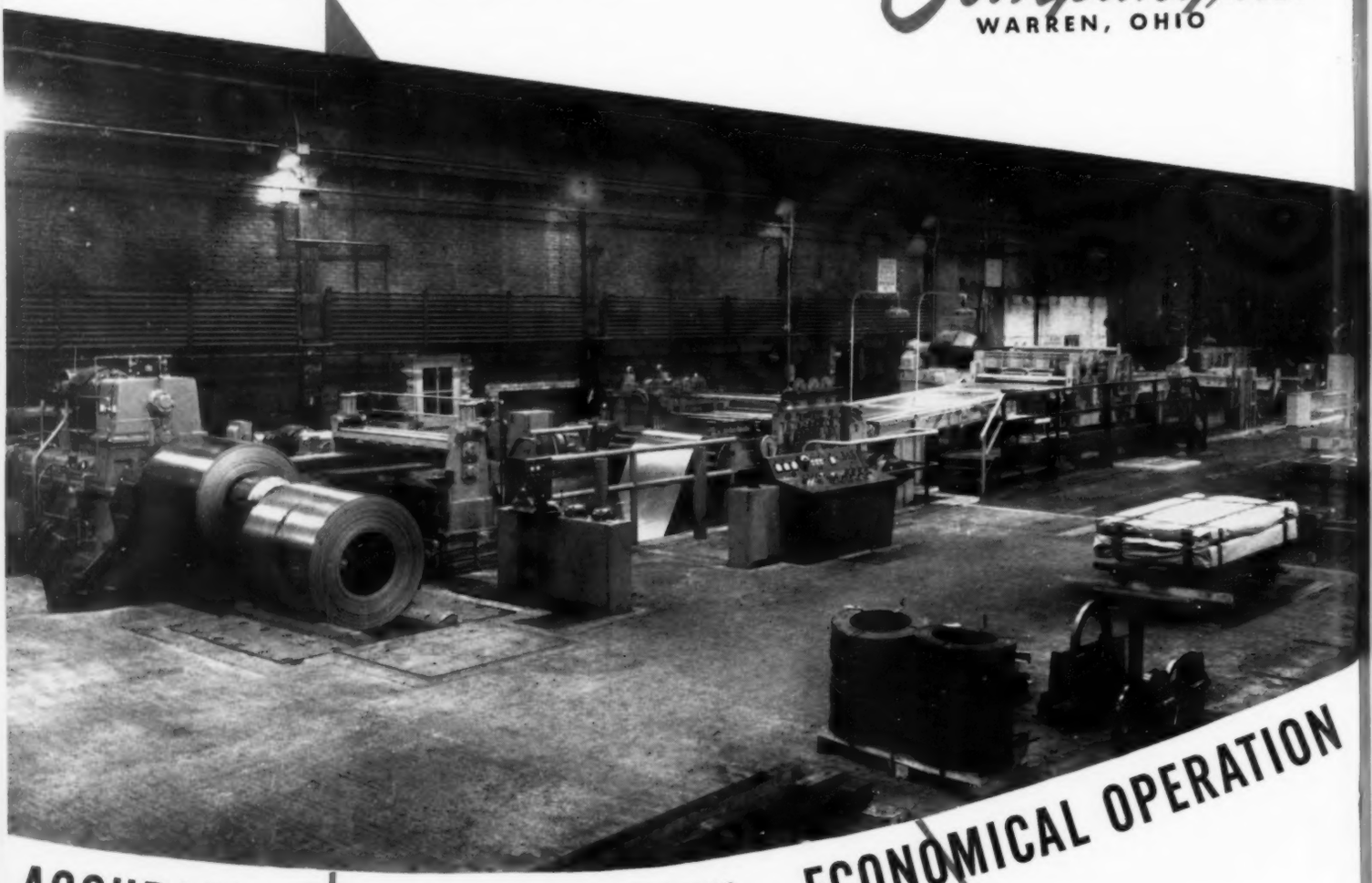
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

Sales Representatives in all Principal Cities

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING

The WEAN ENGINEERING Company, Inc.

WARREN, OHIO



ACCURACY ★ HIGH PRODUCTION ★ ECONOMICAL OPERATION

Faster, more economical production with closer control of product quality — that's the thinking that goes into every Wean engineered sheet, tin or strip mill line.

Leading steel mill officials the world over have learned they can depend on Wean engineers to design and produce equipment unmatched in accuracy, high production and economical operation.

If you're planning production improvements to combat high labor costs, increase your margin of profit or improve the quality of your product, make sure you check first with a Wean engineer.

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Iron and Steel Engineer

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Atlantic Steel Company

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DIXISTEEL

January 4, 1955

J. H. GIRDLER
VICE PRESIDENT
IN CHARGE OF OPERATIONS

Mr. William Wallis, President
Pittsburgh Lectromelt Furnace Corporation
327 - 32nd Street
Pittsburgh 30, Pennsylvania

Dear Bill:

I am sure that you will be interested to know that our JT furnace produced 135,151 net tons in 1954 for an average of 16.6 tons per operating hour.

We operated 8135 hours which was actually more than the planned operating schedule. The actual operating hours were 93% of the total available hours in 1954.

We had only one serious operating delay, and averaged 77 tons per heat. Kilowatt consumption was 500 per net ton, and we used 9-1/2 pounds of electrodes per ton of ingots.

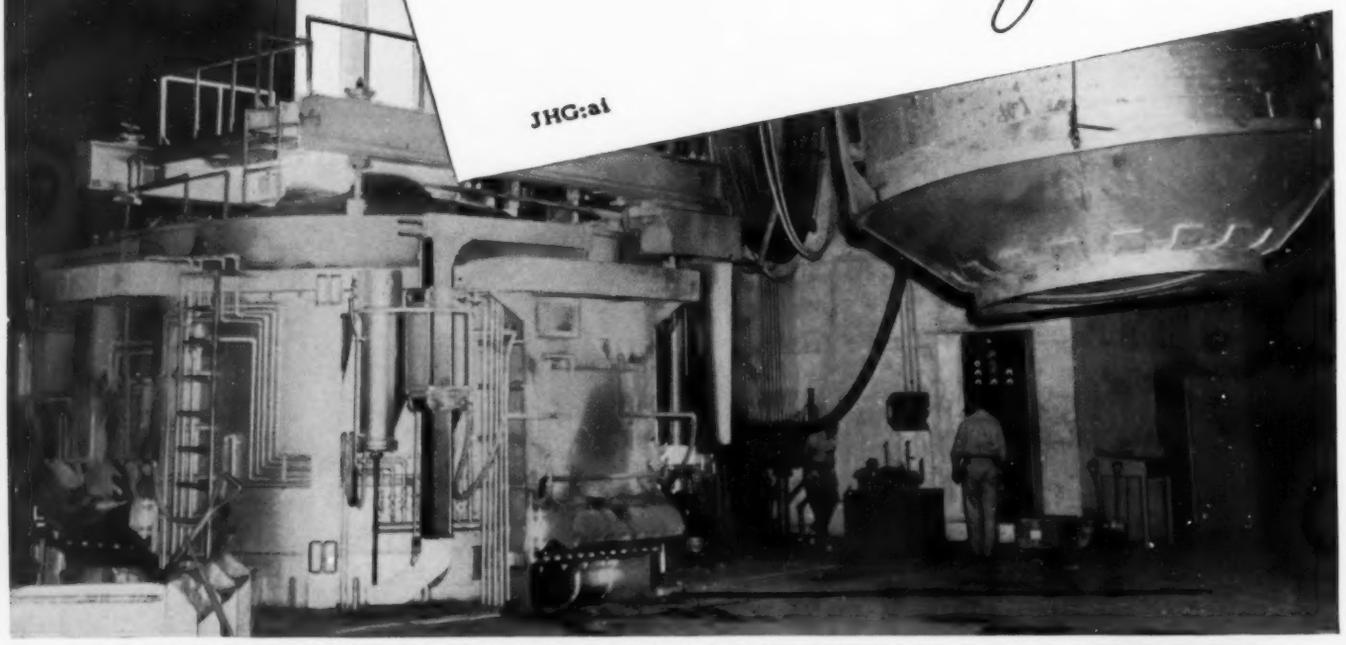
It is a fine furnace and we are proud of it and its operating personnel.

Best regards to all of your fine organization.

Sincerely,

Joe H. Girdler

JHG:al



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*REG. T. M. U. S. PAT. OFF

MOORE RAPID

WHEN YOU MELT... *Lectromelt*

TWENTY FIVE POUNDS TO ONE HUNDRED FIFTY TONS CAPACITY

Economic Aspects of the OXYGEN CONVERTER

By W. C. RUECKEL
Vice President
and
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Kaiser Engineers
Oakland, Calif.

. . . . two oxygen converters can give an annual capacity of almost a million tons per year with lower fixed costs than an open hearth shop . . . . slightly higher material costs of converters are offset by lower "Cost Above," resulting in a net saving through the use of the converter . . . .

Few developments in steelmaking have caught on as fast as oxygen blowing in the bessemer converter.

▲ IN normal manufacturing operations, several questions arise concerning new processes, new developments and new techniques. These questions deal with the economics of the process, with the technology of the process, and with the quality of the product in its effect on product marketability. From the standpoint of the oxygen converter, the latter two questions have been answered in recent trade journals and need no elaboration here. It is the purpose of this paper to investigate the comparative economics of the oxygen converter process. Briefly, the history and development of oxygen converted steel is as follows:

The economic and thermodynamic advantages of pneumatic conversion have been known since the advent of the bessemer converter. However, the product from the bessemer converter is limited in its use because of its properties as affected by the higher content of gases and metalloids as compared to open hearth product. To eliminate these difficulties and retain the advantages of pneumatic conversion, the oxygen converter was developed in Europe reaching the commercial stage within the last few years. This process required more than fifteen years in transition from laboratory experiments through various size pilot plants to the size and scope as we know it today. At the present time, there are three operating plants on the European continent and several in construction on this continent.

Since the open hearth shop accounts for about 90 per cent of the ingot production in this country, it will be used as a standard for cost comparison. In addition, the quality of oxygen converter steel is comparable to the finest product of the open hearth furnace.

In the March, 1954, issue of the "Iron and Steel En-

gineer," a paper entitled "Cost Comparisons of the Open Hearth and Electric Furnace" was presented by David D. Moore. Part of the figures presented in this paper are correlated to Mr. Moore's data so that general comparison can be made. It should be recognized that such topics as "Cost of Metallics" and "Cost Above" are controversial. However, each operator undoubtedly has a measure of comparison in his own cost figures. The construction costs are also subject to some degree of latitude, depending upon the specific items covered by the estimate, but since both sets of cost figures have the same basis, a factor of proportionality can be established.

The production cycle of a 35-ton oxygen converter is about 40 minutes; made up of 20 minutes blowing and 20 minutes idle. The idle time is consumed in skimming, testing, pouring and charging. Thus, the production rate of an oxygen converter is 52 tons per hour or 450,000 tons per year. A second converter can be installed with its production cycle staggered so that it would be blowing while the first converter was idle. This procedure would double the capacity of the plant without materially increasing the size or quantity of auxiliary equipment, other than the oxygen plant. Correspondingly, the production rate of a modern open hearth furnace using hot metal is about 21 tons per hour. On the basis of 90 per cent furnace availability, the net production rate is 18 tons per hour or 160,000 tons per year. Clearly then, one oxygen converter has about the same production capacity as three open hearth furnaces. The economic study will be based on two plant capacities of 500,000 and 1,000,000 annual tons corresponding to one or two converter vessels, and then to three or six open hearth furnaces.

Table I shows the estimated construction costs for oxygen converter shops and open hearth shops of approximately 500,000 annual tons and 1,000,000 annual tons. "Buildings" include the open hearth building, stock house, teeming building, etc. "Equipment" includes furnaces, vessels, ladles, buckets, molds, stools, charging machine(s), cranes, mixer(s), etc. The open hearths chosen for this particular study were 275-ton capacity. The oxygen converter vessels chosen were two 35-ton capacity (one operating and one standby) and three 35-ton capacity (two operating in sequence and one standby). "Utilities" includes water piping, steam piping, electrical distribution system, wiring and, for the oxygen converter, an oxygen plant of suitable capacity. "Air Pollution" includes waste heat boilers, filtration equipment, duct work, sludge piping, etc. "Storage facilities" include trackage, scrap yard, slag disposal, flux storage, etc.

The actual installed cost of a conversion shop is widely variable, depending not only on the type and design of the equipment, but on the restrictions imposed by the particular plant site. Therefore, the figures may vary from an actual installation cost, but the relative proportions will remain essentially the same. The wide variations in cost for an oxygen converter shop and an open hearth shop lie principally in buildings and in equipment. In view of the small size of the oxygen converter as compared to the open hearth, less building area is required. In addition, lighter live loads and dead loads result in less expensive columns, beams and floors, reducing the cost per unit area. The equipment costs are lower for an oxygen converter shop, not only because of the lower cost of the vessel as compared to three open hearth furnaces, but also because of the lighter cranes and other auxiliary equipment. The reason for the smaller rate of increase for the oxygen converter shop as the capacity increases from 500,000 to 1,000,000 tons per year is due to the fact that at the lower capacity, virtually 100 per cent standby equipment is required. With the increase in capacity, virtually all funds are allocated to productive equipment. This margin does not appear for the open hearth.

Table II shows the burden and materials cost per ton of tapped steel for the oxygen converter process and for the open hearth furnace. For comparison purposes, the hot metal ratio of the open hearth furnace has been increased to the same rate as the oxygen converter (78 per cent) although this ratio is higher than used in normal practice. In view of the fact that at this time hot metal is lower in cost than scrap, the increase in hot metal operates to the advantage of the open hearth. The calculations from which this data is taken are based on the principles of thermo-chemistry given in "Basic Open Hearth Steelmaking,"[1] "Metallurgical problems,"[2] and "Fuel Flue Gases."[3] (See Bibliography at end of paper).

The materials cost per ton of tapped steel shows a cost advantage of $0.74 per ton for the open hearth furnace. The principal factor in this cost advantage is from the metallic iron reduced from the ore. This was obtained at an equivalent cost of about $20.00 per net ton of iron. This apparent advantage is offset by fuel required to reduce the ore to metallic iron and these costs appear in "Cost Above." If the conventional hot metal ratio of 60 per cent were used, the materials cost

TABLE I

	450,000-Ton annual capacity oxygen converter	525,000-Ton annual capacity open hearth	900,000-Ton annual capacity oxygen converter	1,050,000-Ton annual capacity open hearth
1. Buildings	$ 900,000	$ 5,700,000	$ 1,200,000	$ 9,300,000
2. Equipment	1,900,000	10,000,000	2,400,000	19,200,000
3. Utilities	2,600,000	1,600,000	3,400,000	1,900,000
4. Air pollution control	1,500,000	1,500,000	2,000,000	3,000,000
5. Storage facilities	2,200,000	2,000,000	2,400,000	2,000,000
Total	$ 9,100,000	$20,800,000	$11,400,000	$35,400,000
Cost per annual ton	$ 20.22	$ 39.61	$ 12.67	$ 33.71

for an open hearth furnace would be about $37.50 per ton or an increase of $0.83 per ton over the higher hot metal ratio. At 50 per cent hot metal in the open hearth furnace, the materials cost would be $38.18 per ton. As might be expected then, on the same basis, the materials costs for the two processes are relatively close together (within 2 per cent).

TABLE II

	Oxygen converter		Open hearth	
	Lb per ton of steel	Cost	Lb per ton of steel	Cost
Steel scrap at $43.00 per gross ton	475	$ 9.03	438	$ 8.32
Hot metal at $33.00 per net ton	1650	27.23	1465	24.17
Iron ore at $14.00 per gross ton			380	2.38
Deoxidizers		0.75		1.20
Scale		0.40		0.60
		$37.41		$36.67

Table III shows the "Cost Above" per ton of steel for the oxygen converter process and for the open hearth furnace. As the oxygen converter requires no external source of heat, one of the major savings in cost is fuel. The fuel cost, per ton of steel, does not change with increased shop capacity and is affected only by the heat requirement of the open hearth process, which is about 3,300,000 Btu per ton. If the oxygen required for the oxygen converter is deducted, the net fuel cost for the open hearth furnace is $1.18 higher than for the oxygen converter. The cost of fluxes is considerably higher for the oxygen converter because it becomes advantageous to use principally burnt materials such as burnt lime instead of the raw stone. Part of the fuel costs shown above are dependent upon the calcination of the $CaCO_3$. Furnace refractories and furnace repair are less for an oxygen converter for several reasons. From the standpoint of durability, the lining life of existing oxygen converters is about 230 heats or about 8,000 tons. Present practice is to recover as much of the lining as possible for re-use in tar pressed bricks and tamping clay. The net consumption of refractories is 30 lb per ton for the oxygen converter, as compared to 80 lb per ton in an open hearth furnace.[4] It is assumed that the masonry labor will be directly proportional to the quantity of refractory. Production labor, developed from comparative force reports, show that the labor cost of an oxygen converter shop is about half of that of an open hearth furnace shop. In view of the simplicity of the oxygen converter, maintenance labor and materials, supplies, tools and lubricants will also be about 60 per cent of the cost of an open hearth installation. The quantity of oxygen required for conversion is 0.08 tons per ton of steel, and since oxygen can be produced for about $10.00 per ton in the quantity required[5], the cost of oxygen will be $0.80 per ton of steel. To that must be added the cost of oxygen for the remainder of shop uses ($0.20 per ton) giving a total cost of $1.00 per ton. Employee benefits are related to total wages and have been so proportioned. The other elements of "Cost Above" are related to the total production and should not be affected appreciably by the specific conversion process. No credit has been taken for byproduct recovery, such as flue dust and steam, which would amount to about $0.60 per ton.

This is based on the average generation of 1000 lb of steam per ton of steel.

TABLE III

	500,000 tons		1,000,000 tons	
	Oxygen converter	Open hearth	Oxygen converter	Open hearth
1. Fuel (0.60 per MM Btu)		$ 1.98		$ 1.98
2. Fluxes	$ 1.17	0.50	$ 1.17	0.50
3. Furnace refractories	0.30	0.70	0.30	0.70
4. Ladle refractories	0.15	0.15	0.15	0.15
5. Furnace repair	0.60	1.50	0.60	1.50
6. Molds and stools	0.65	0.65	0.65	0.65
7. Production labor	0.80	1.60	0.80	1.60
8. Maintenance labor and materials	0.42	0.70	0.33	0.55
9. Oxygen	1.00	0.20	1.00	0.20
10. Supplies, tools and lubricants	0.16	0.20	0.16	0.20
11. Water, steam and power	0.30	0.30	0.30	0.30
12. Yard switching	0.20	0.20	0.20	0.20
13. Slag disposal	0.30	0.30	0.30	0.30
14. Indirect labor	0.20	0.20	0.20	0.20
15. Employee benefits	0.30	0.30	0.30	0.30
16. General expense	0.40	0.40	0.40	0.40
Sub total	6.95	9.88	6.86	9.73
17. Fixed charges (at 12 per cent)	2.42	4.75	1.52	4.52
Total	$ 9.37	$14.63	$ 8.38	$14.25

The cost studies presented here are perhaps theoretical to some degree. Where possible, they are based on the experience of the existing Austrian oxygen converter shops with due allowance for conditions in this country. In those cases where data is lacking, experience from bessemer converter plants was used as a basis of cost estimation. In the remainder of the cases, the knowledge of the requirements of the process as compared to an open hearth furnace was used to develop the cost figures.

It is the opinion of the authors that the economic importance of the oxygen converter process is so compelling that the process must be given detailed study and evaluation for any program involving plant modernization or involving an increase in ingot capacity.

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DISCUSSION

PRESENTED BY

STEPHEN VAJDA, Staff Engineer, Jones and Laughlin Steel Corp., Pittsburgh, Pa.

N. W. TREPANIER, Supervisor, Project Engineering Section, Steel Div., Ford Motor Co., Dearborn, Mich.

D. C. McCRADY, Superintendent Electrical Dept., Steel Co. of Canada, Ltd., Hamilton, Ontario, Canada

C. C. BENTON, Superintendent of Open Hearths and Bessemer, Algoma Steel Corp., Ltd., Sault Ste Marie, Ontario, Canada

J. W. IRVIN, Associate Engineer, Kaiser Engineers, Oakland, Calif.

Stephen Vajda: As Messrs. Rueckel and Irvin point out in the beginning of this very timely paper, several questions always arise concerning new processes, developments, and techniques. Of the three items listed—economics, technology, and marketability—economics, as all department heads have found, causes the greatest casualties.

A masterpiece of understatement in the paper is the sentence to the effect that the topic of costs is controversial. It is true that figures never lie, but it is amazing how the same figures can tell different stories—often diametrically opposed.

Since the basic figures and assumptions are not available, I am in no position to question the installation and construction cost figures. But, comparing the cost of a similar open hearth installation as presented by the Bituminous Coal Research in their "Comparative Economics of Open Hearth and Electric Furnaces for the Production of Low Carbon Steel," the figures seem to be in line. Actually, even if the open hearth capital costs were reduced 25 per cent, it would not alter the conclusion that the investment cost per ton of capacity for the oxygen bessemer is from 50-60 per cent less than that of the same sized open hearth.

However, I would like to raise a point of order on one or two assumptions. A modern 275-ton open hearth should make at least 23 ton per hour and should have at least 95 per cent availability. Using such figures, only 5 furnaces are needed for a 900,000-ton per year plant for comparison with the converter plant.

In their discussion of the pneumatic conversion process, the authors say that by staggering the production cycle—i.e. blowing the second vessel, while the first is idle—the capacity can be doubled "without materially increasing the size or quantity of auxiliary equipment, other than the oxygen plant." Why should the oxygen plant be affected?

The use of 78 per cent hot metal in calculating the "Cost of Metallics" and "Cost Above" for the open hearth seems unrealistic, since there are very few companies, if any, capable of attaining such a practice. The use of 50-60 per cent hot metal would have had more practical use.

The figures on materials cost are a little puzzling. For instance, the authors give a figure of $38.18 per ton for 50 per cent hot metal. The scrap and hot metal alone cost $39.38—using 1100 lb of each at the same rates as in the table.

It would seem from the paper that the oxygen bessemer in a new integrated installation has a decided advantage over the open hearth in all three categories—capital cost, cost of materials and cost above. For increasing ingot capacity, the capital cost item loses some of its importance in an existing integrated plant without sufficient hot metal capacity. It would be interesting to calculate how low one can afford to reduce the hot metal practice in existing open hearths so as to install converters. Of course, the converter has no interest to a plant without a source of hot metal.

In checking the various figures used in this paper with those in the comparison of electric furnace vs. open hearth mentioned above, some interesting facts came to light. The investment cost for an electric furnace capacity of 500,000 or 1,000,000 tons per year was within 2 per cent that of the conversion process—2 per cent less for 500,000 ton and 2 per cent more for 1,000,000 ton. Using 50 per cent hot metal charge, the costs are in the same proportion as the open hearth; about 10 per cent more for the "Cost of Materials" and 70-80 per cent more for the "Cost Above."

The question then arises as to what extent the increase in yield from an electric furnace would nullify these higher costs using 88 per cent yield for open hearth and converter and 90 per cent for the electric furnace. There is also the item of greater flexibility with the electric furnace. The converter, as I understand it, will make open hearth grade carbon steels. The electric furnace, on the other hand, can also produce alloys which are a higher profit item. In addition, one must have a completely integrated plant for the oxygen bessemer—coke works, blast furnace, etc., to supply hot metal, whereas an electric furnace can be 100 per cent scrap charge.

N. W. Trepanier: I would like to ask if any consideration has been given to two points:

1. The oxygen purity in relation to the cost of an oxygen plant.
2. What, if any, analysis has been given to the type of dust collection equipment that could be used in such a plant.

D. C. McCrady: I would like to ask how much installed horsepower is required for only the oxygen plant for, say a 500,000 ingot ton a year installation?

C. C. Benton: On these cost information figures, I assume that was an entirely new operation. A number of shops in operation at present are burning about 60-70 per cent coke oven gas. If this was taken into consideration what would your comparative fuel figures be?

J. W. Irvin: First in reply to Mr. Vajda's statement concerning 95 per cent furnace availability and production rate of 23 tons per hour for new 275-ton furnaces, Mr. Vajda's performance figures are very well taken although they do not represent industry averages for existing open hearth shops. I think more usual figures from the availability standpoint as well as from a net production standpoint are somewhat in line with the figures that I presented.

Second, Mr. Vajda asked a question about how the oxygen plant capacity is affected. Using a figure of 52 tons an hour for a single converter and 0.08 tons of oxygen per ton of steel, one arrives immediately at about 4 tons of oxygen per hour consumption. If you put in two converters it seems to me you will have double that consumption. Therefore, it would be advisable to put in sufficient oxygen capacity initially, perhaps, except that from the standpoint of cost comparison we had contemplated an oxygen plant capacity of 4 tons an hour in one case and 8 tons an hour in the other case.

You might be interested to know that some of the European installations ran into this specific problem, in that their oxygen converter capacity as such exceeds the capacity of the oxygen plant. As a rule, they are forced to curtail operations in the converter to allow the oxygen to catch up.

I would like to make one other point clear. I do not think that any of us who are familiar with and associated with the oxygen converter process feel that the oxygen converter is going to replace every open hearth. We do not feel that it is going to replace every electric furnace, and we do not even expect that it is going to replace every bessemer converter in the country. However, we believe there is a place for the oxygen converter alongside the open hearth, where it can do the job better than the open hearth. There is a place for the oxygen converter alongside the electric furnace where it can do the job better than the electric furnace.

Mr. Trepanier asked about the oxygen purity in relation to the cost of the oxygen plant. Our best estimates of the cost of an oxygen plant of suitable capacity would be about $2,000,000, that would be capable of producing oxygen of, say, 97.5 per cent purity plus, which, incidentally, is adequate for the oxygen converter.

The next question asked about the dust-collecting equipment. The figure was given, of $1,500,000 for air pollution control equipment. Detailed studies were made by Kaiser Engineers on various types of air pollution equipment, and by that I mean all of the conventional types, such as disintegraters, filters of various and sundry kinds, including electrostatic precipitators, and we came to the startling conclusion—at least to us—that the cost of each installation was within five or six per cent of the average cost, and therefore we concluded that the particular type of air pollution equipment to be used depended more upon actual plant conditions than it did upon anything else. All of them are predicated upon designs that will do the job to an equal degree of satisfaction, regardless of which particular type of air pollution equipment is chosen.

Mr. McCrady asked about the connected horsepower for the oxygen plant portion of an oxygen converter installation of 500,000 annual tons of capacity. This would require a 100-ton per day plant and would involve a connected load of 2500 kw.

Mr. Benton, of Algoma, asked what effect the cost above the fuel cost would be if you had an excess of coke capacity. The fuel cost that we used in the particular study was based on a fuel cost of 60 cents a million Btu. Now, we felt that that figure was realistic, and that it was virtually independent of the type of fuel used. If you had excess fuel, perhaps it has a market value, but we have used 60 cents a million Btu without regard to the type of fuel. Even if no value were placed on the fuel consumed in the open hearth, the "Cost Above" for a 500,000 annual ton open hearth shop would be $3.28 per ton more than for the oxygen converter shop.

1955 AISE

ANNUAL CONVENTION

SEPTEMBER 26, 27, 28, 29

HOTEL SHERMAN CHICAGO, ILL.

the VENTURI WASHER for Blast Furnace Gas

By DR. J. E. EBERHARDT
Division Head
and
H. S. GRAHAM
Engineer
Research Dept.
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Bethlehem, Pa.

. . . . new venturi type blast furnace gas washer promises efficient cleaning at water consumptions as low as five gallons per thousand cubic feet of gas . . . . space requirements and capital costs are appreciably less than in the conventional types . . . .

▲ THIS paper presents results obtained with a pilot plant venturi gas washer with a nominal capacity of 25,000 cfm of gas, and a plant scale venturi gas washer with a nominal capacity of 85,000 cfm of gas. The pilot plant data indicate that within the range of the data, the dirt content of the cleaned gas is dependent on the gas pressure loss across the venturi section; the range covered is from a dirt content of 0.09 gr per cu ft, at a pressure loss of 7 in. of water, to a dirt content of 0.015 gr per cu ft at a pressure loss of 24 in. of water. The gas pressure loss depends upon the gas flow rate and the water ratio (gal of water per thousand cu ft of gas); a correlation is presented.

The water required for cleaning is approximately 5 gal per thousand cu ft of gas, rather than upwards of 20 gal per thousand cu ft of gas for conventional primary washers. The effect on the required size of thickeners is apparent.

No blockage occurred in either the venturi sections or the cooling towers during a year of operation of the pilot plant and nearly two years of operation of the plant scale unit. No wear or erosion of the venturi linings was detectable and no maintenance of the plant scale unit has been required.

The steel industry is paying considerable attention to the dust content of blast-furnace gas used in blowing engines, hot-blast stoves and boilers, particularly in view of rising costs for the maintenance of these blast-furnace auxiliaries. In many plants the secondary gas-cleaning equipment, such as electrostatic precipitators and disintegrators, is already overloaded or operated above design capacity, and a lower dust loading in the fine-cleaned gas probably can be attained most readily by an improvement in the primary gas cleaning. Further, it will appear that the gas washer to be described is itself capable of cleaning gas to a degree which makes the gas suitable for some applications.

A recently developed method of primary gas cleaning, the venturi washer, has been studied at the Bethlehem, Pa., plant of the Bethlehem Steel Co. A preliminary study was made of the performance of a small pilot scale venturi washer and on the basis of this preliminary investigation, the study was extended to a larger pilot unit with a nominal capacity of 25,000 cfm and thereafter to a plant scale unit.

The venturi gas washer operates on the same principle as other systems of wet gas cleaning — wetting the dust particles with liquid, followed by separation of the dust-laden drops of liquid from the gas. It differs in the way in which the water is atomized. In the usual system, water is atomized by hydraulic pressures, whereas in the venturi, water at relatively low pressure is atomized by injection into a high velocity gas stream. At gas velocities of the order of 200-400 fps the droplets of water become extremely small, thus making available a very large surface of liquid film for wetting the dust particles. The mechanism of wetting the dust particles is complicated, but undoubtedly it is a combination of impaction of the dust particles with the liquid surface, together with diffusional and electrostatic effects due to the charging of water droplets by atomization in the extremely turbulent region existing in both gas and liquid in the vicinity of the water jets. Descriptions of the development of the venturi washer, theory of opera-

tion and data on its performance in absorption, humidification and dust and sulphuric-acid mist collection have been published in the literature; references are listed at the end of this paper.

DESCRIPTION—18-in. PILOT UNIT VENTURI WASHER

Raw furnace gas from the dry dust catchers, at a temperature of 350-600 F, was passed vertically downwards through the brick-lined venturi section, then upwards through a cooling tower packed with wood grids, and finally into the primary gas main, as shown in the flow sheet, Figure 1. Figures 2 and 3, show the washer and cooling tower and a closeup of the throat section.

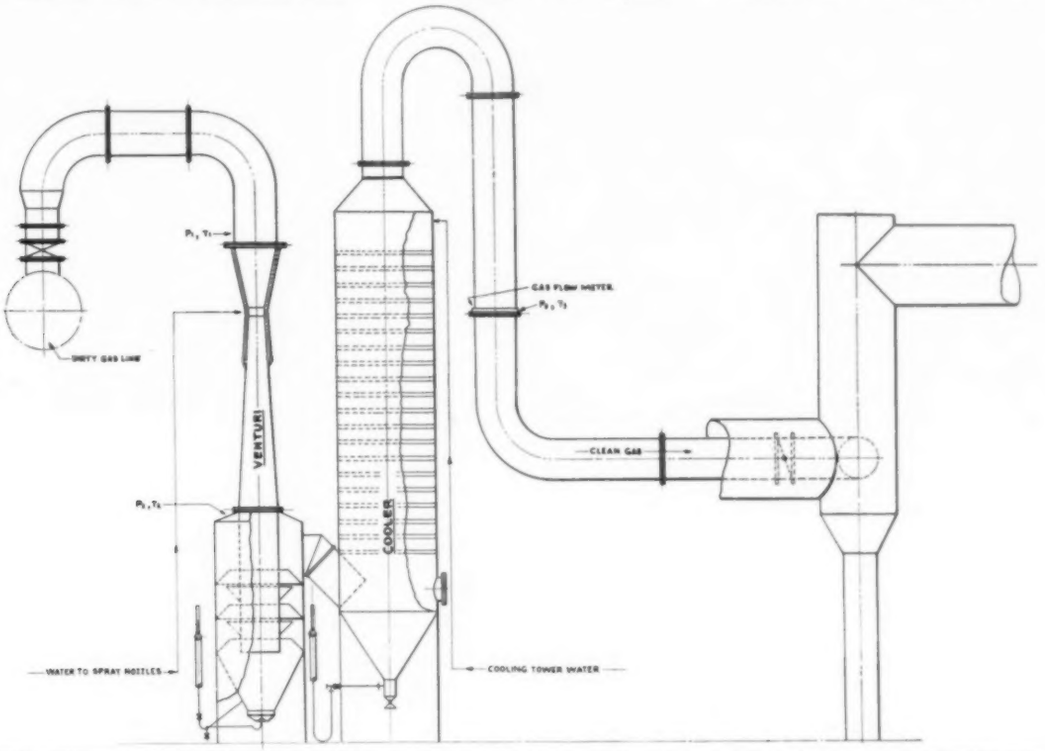


Figure 1 — Flow sheet shows operation of pilot plant venturi gas cleaning system.

The function of the venturi shape is twofold: the converging section is used to accelerate the gas and the diverging section to obtain recovery of some of the kinetic energy. These sections were lined with a fused cast refractory material to resist the severe erosive condition imposed by the high velocity dust-laden gas.

Water was injected at the throat through 18 nozzles, the ends of which were flush with the inside of the throat, located around the periphery and inclined upwards 20 degrees into the approaching gas stream (see Figure 3). On account of the erosive conditions, particularly at the throat, the nozzles could not be placed in the gas stream as in some other applications of the venturi washer; however, this is an advantage in maintaining the nozzles since they can be removed from the outside and cleaned individually without necessitating a shut-down of the washer. Nine of these nozzles had single $\frac{7}{32}$-in. holes and covered the center area of the throat; the other nine had three holes, two $\frac{7}{32}$ and one $\frac{3}{16}$-in. diam, and covered the remaining annular area. Water pressure required at the nozzles was 40 to 60 psig for the single hole nozzles and 10 to 30 psig for the three-hole nozzles. The relative amounts of water introduced through the two sets of nozzles were adjusted for adequate coverage of the throat area, according to the spray patterns obtained in preliminary tests when air was pulled through the venturi by a fan. A ratio of 40:60 (40 per cent through the single-hole and 60 per cent through the three-hole nozzles) on the water flow rates was used in most of the tests, although this ratio was varied.

The gas and water flow rates, temperatures and pressures were recorded by meters for the points indicated schematically on Figure 1. The pressure drop from inlet to outlet of the venturi section, P_1-P_2, was read directly on a "U" tube. During a dust test the gas flow rate was held substantially constant by an automatically controlled butterfly valve as indicated in Figure 1. The point at which the dust tests were taken was just upstream from the butterfly valve. A total of 208 dust tests was made over a period of a year and one-half and at various conditions of gas and water flow rates.

RESULTS—18-in. PILOT UNIT VENTURI WASHER

1. *General correlation* — The results indicate that the dirt content of the cleaned gas is dependent upon the loss in gas pressure across the venturi section. The loss in gas pressure depends on the gas flow rate and the water ratio (gal of water per thousand cu ft of gas).

Figure 4 presents average values of the dust loading in the cleaned gas plotted against average values of the corresponding pressure drop across the venturi. The dust loading and pressure drop data were averaged for two-in. increments of pressure drop (i.e. tests with pressure drop in the range of 12 to 14 in, 14 to 16 in., etc). Dust tests excluded were those made when: (1) the sprays were partially plugged, as indicated by abnormal water pressure for a given water rate, (2) the zinc content of the burden was abnormally high (see below), (3) the furnace was casting, and (4) the water ratio was less than 3 gal per thousand cu ft.

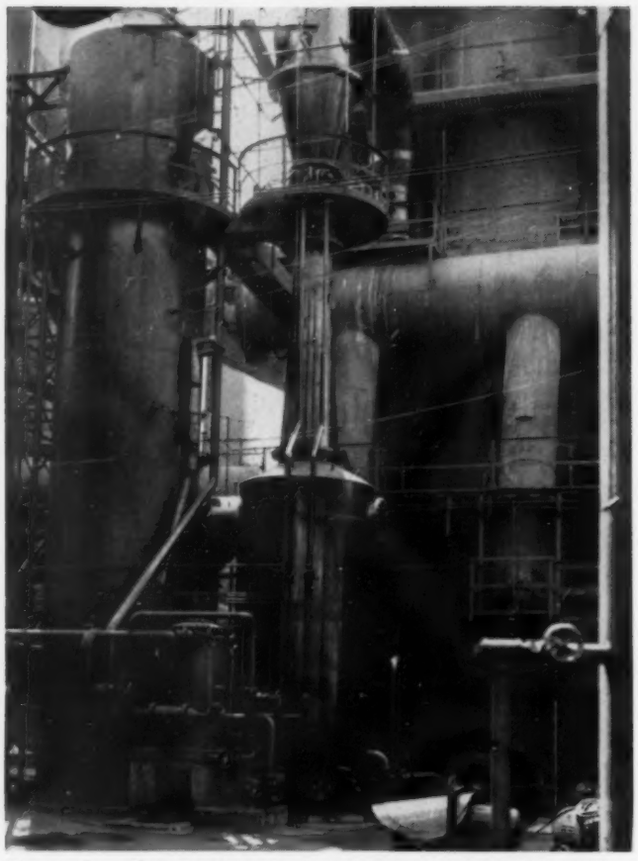


Figure 2 — Relatively little area is required for the washer and cooling tower.

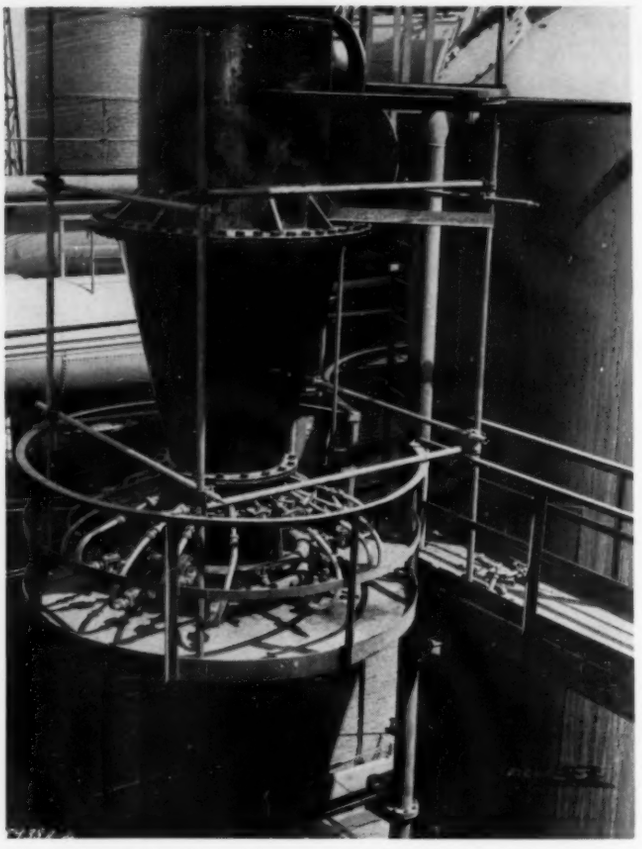


Figure 3 — Close-up of throat section shows placement of nozzles.

When the data are plotted on semilog paper (Figure 4), a straight line can be drawn through the points. It therefore appears that the dust loading in the cleaned gas is a function primarily of the pressure drop. This is equivalent to saying that for a given pressure drop, the same average dust loading can be obtained with a high water ratio and low gas flow rate, as with a low water ratio and a correspondingly higher gas flow rate. This, of course, may not be true outside the range investigated. At water ratios of less than 3 gal per thousand cu ft, the dust loadings tended to be slightly higher than the average of tests at water ratios above 3 gal per thousand cu ft, particularly for low gas flow rates. This was probably caused by insufficient coverage of the throat with spray, although this limitation will not necessarily apply to other shapes of venturi throats or other water nozzle arrangements.

In Figure 5 are presented both the above correlation (Figure 4) of pressure drop vs dust loading and the correlation for pressure drop vs water ratio at seven gas flow rates. Note that the gas flow rates are expressed as cfm of gas (at 60 F and 30 in. mercury pressure) per sq ft of cross-sectional area of the throat. This expression has the dimensions of fpm, although it may not be the actual linear velocity of the gas in the throat. The shaded area representing water flow ratios less than 3 gal per thousand cu ft corresponds to operating condi-

Figure 4 — Dust loading of clean gas is reduced as pressure drop through venturi section is increased.

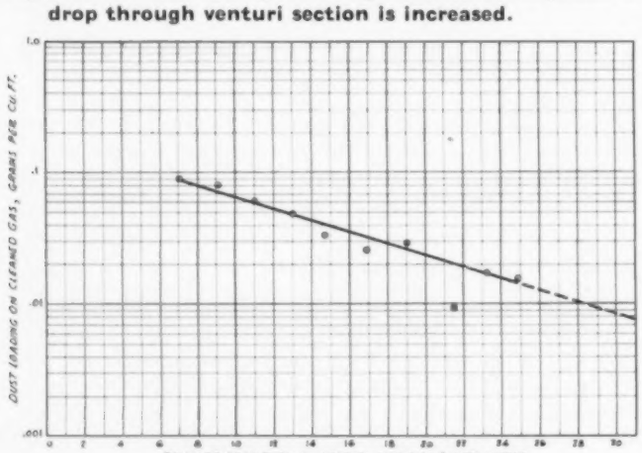
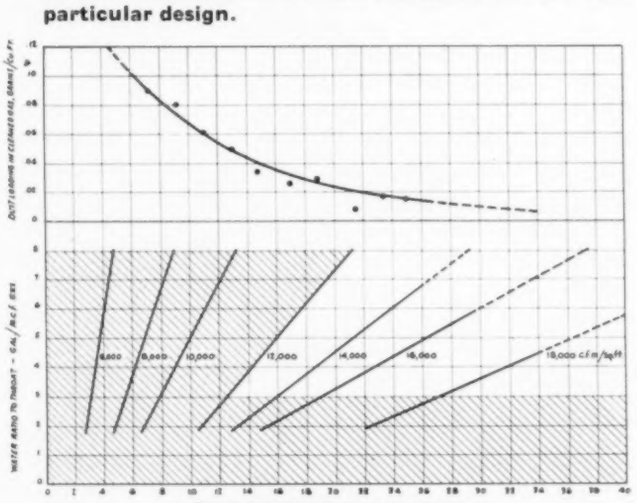


Figure 5 — Water flow ratios less than three gallons per thousand cubic feet are not recommended for this particular design.



tions which are not recommended for this particular design, as explained above. The shaded area representing gas flow rates of less than 12,000 cfm per sq ft corresponds to operating conditions which, it is suggested, do not realize the potentialities of this gas washer.

The unshaded area depicts the range of operating conditions within which, it is felt, the full potentialities of this gas washer can be realized; for example, at a pressure drop of 22 in. of water across the venturi section, the dust loading in the cleaned gas will be about 0.02 gr per cu ft. This pressure drop is obtained at gas flow rates in the range of 12,500 to 17,000 cfm per sq ft with corresponding water ratios of 8 to 3 gal per thousand cu ft respectively, or at various conditions within this range.

The gas at the Bethlehem plant contains zinc oxide fume which is very difficult to remove. Fourteen tests made on the venturi during a period when the zinc in the burden was substantially higher than normal showed a dust loading nearly twice that predicted by Figure 4. During this same period, the dust loading in the gas cleaned in the precipitators also increased. Since all the dust tests on the venturi were made on gas containing some zinc oxide fume, it is reasonable to expect that lower dust loadings would be obtained when no zinc oxide or other fumes are present.

2. *Cooling tower* — The gas was cooled in the venturi section from about 450 to 130 F; a cooling tower following the venturi served to cool and reduce the water-vapor content of the cleaned gas further. The tower was packed with 19 single banks of wood grids at 15-in. spacing. Cooling water at a rate of about 20 gal per thousand cu ft of gas entered the top and flowed downwards, counter current to the gas. The gas leaving the tower was cooled to within about 5 F of the inlet water temperature at rated gas flow rate. Since the water leaving the bottom of the tower contained very little dirt picked up from the gas, it was sent directly to the sewer, and kept separated from the water from the venturi section which was sent to the thickener. The thickener capacity required for this gas washer was, then, only 3 to 5 gal per thousand cu ft rather than upwards of 20 gal per thousand cu ft presently used in primary washers.

3. *Erosion of venturi lining* — No erosion of the fused cast refractory lining was observed when it was inspected after 11 months of actual operation, and measurements show no increase in cross-sectional area.

DESCRIPTION—PLANT SCALE VENTURI WASHER

The flow sheet of the plant scale venturi washer system is shown in Figure 6. It will be noted that the system is generally similar to the pilot plant, previously described. Two changes are to be noted: the venturi throat is rectangular in cross section, and the cooling tower contains no packing.

The purpose of the rectangular-shaped throat section, instead of a circular section, was to reduce the penetration distance required of the water sprays, and to simplify the arrangement of nozzles. Penetration distances

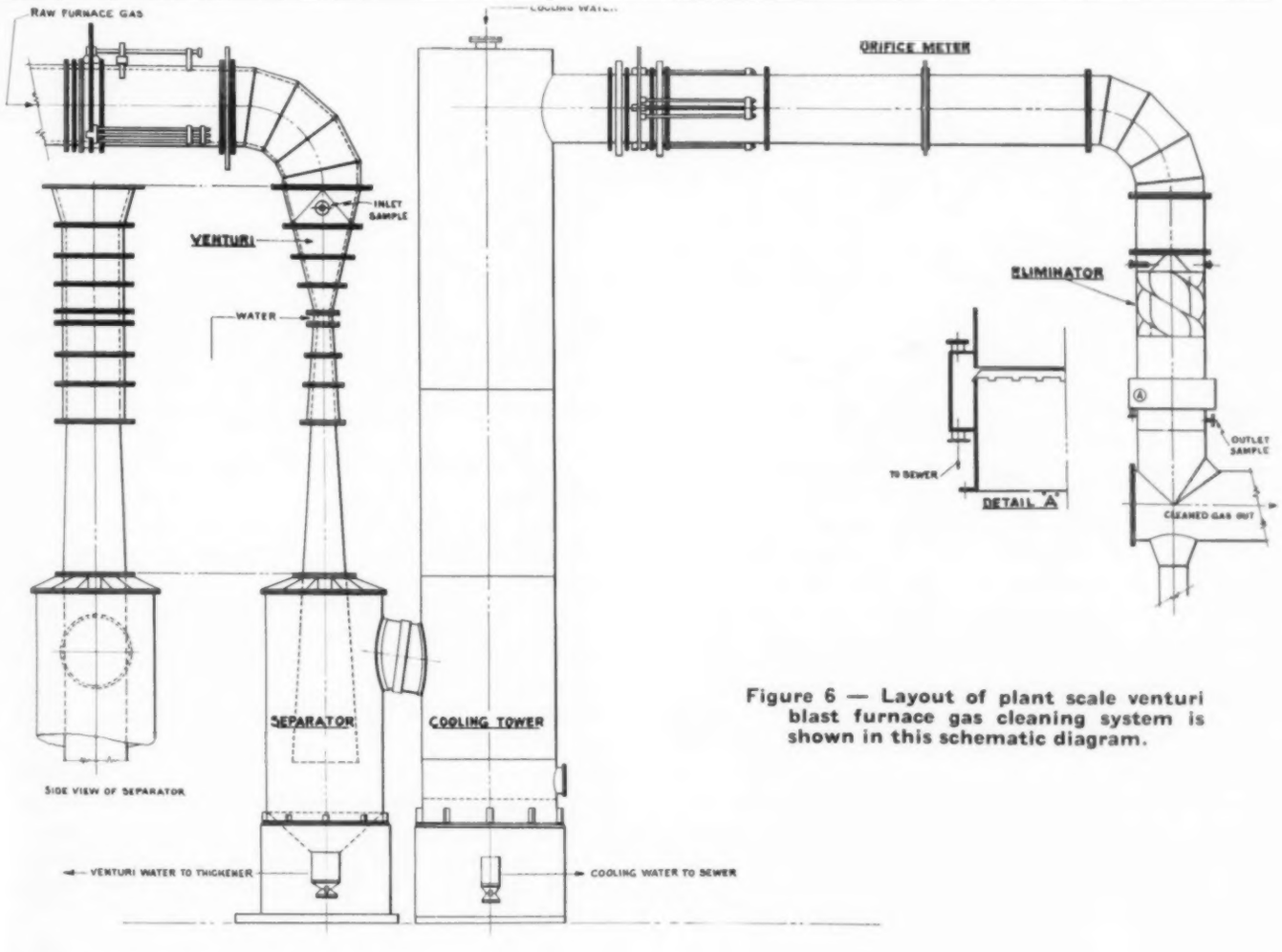


Figure 6 — Layout of plant scale venturi blast furnace gas cleaning system is shown in this schematic diagram.

for this washer in a circular throat would have been nearly twice that required in the 18-in. pilot unit, requiring a more complicated arrangement of spray nozzles. A rectangular section, on the other hand, can be covered uniformly by a much more simplified arrangement of nozzles placed along the two long sides of the rectangle. Again, it should be noted that placement of the water nozzles and headers inside the throat, as is done in many other applications of the venturi washer, is precluded for blast-furnace gas by the severe erosion imposed by high-velocity dust-laden gas.

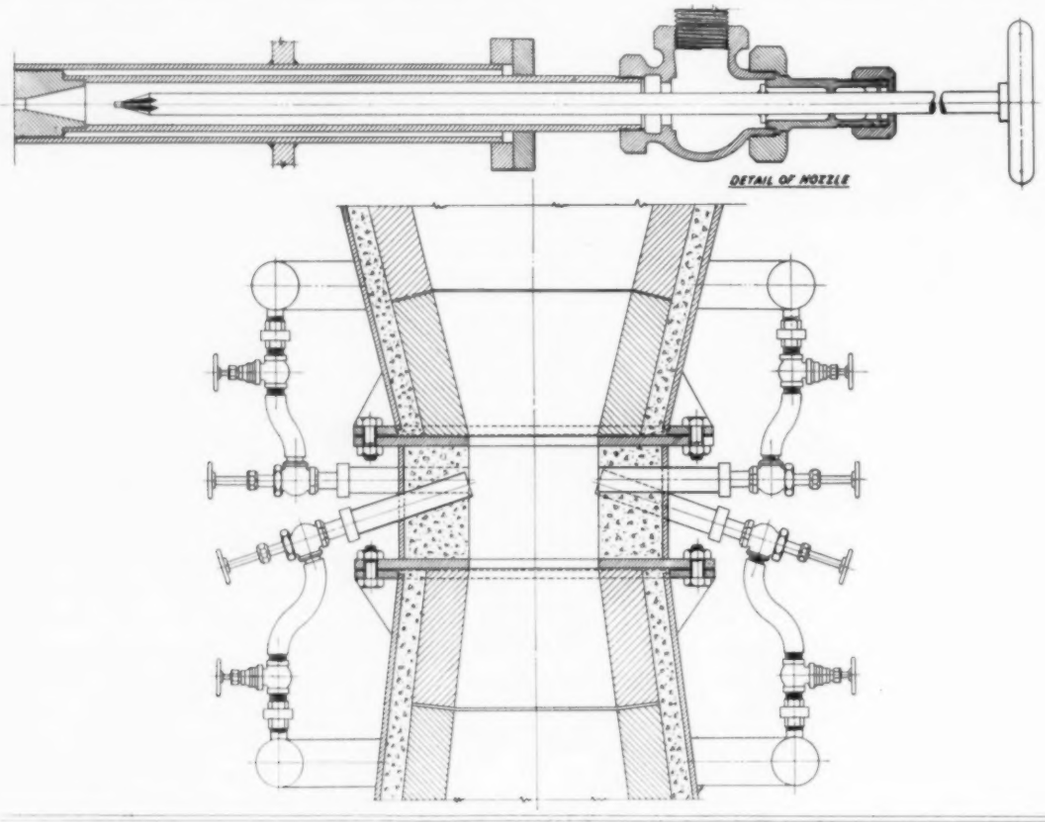


Figure 7 — Detail shows water nozzle and throat section of venturi washer for blast furnace gas

The inside dimensions of the throat section are 12 × 64 in.; a total of 62 nozzles, 2½ in. on centers, along the two long sides of the throat, are placed as shown in Figure 7. Each of the nozzles, inclined at an angle of 20 degrees, is opposed by a horizontal nozzle and each has a single hole, 5/16 in. diam. The inclined nozzles were designed to penetrate approximately two-thirds and the horizontal nozzles one-third of the 12-in. throat width and to use the corresponding fraction of the total water.

In the pilot plant it was possible to remove and clean an individual water nozzle without shutting down the washer. In the plant-scale venturi, a further refinement was incorporated, namely, provision for cleaning the water nozzles in place. This was done by incorporating a reamer into each nozzle, shown in the detailed view of Figure 7. These reamers proved to be very effective because all 62 nozzles could be cleaned in a matter of 3 to 5 min without the use of any tools, consequently, it is easy for the operators to keep the nozzles clean and the venturi washer operating at peak efficiency. Without routine cleaning, the nozzles soon become plugged by the dirt in the raw river water, especially during periods of high water.

The cooling tower was designed to cool the gas from the venturi section by means of water distributed by 22 narrow-angle nozzles which produce a coarse spray of water raining down through the rising gas stream. Tower packing is not necessary in this design. Since substantially no dirt is picked up by the cooling water in passing through the tower, it is returned directly to the river. The water from the venturi is pumped to the thickener for clarification before being returned to the river.

Water entrained with the gas leaving the cooling tower is separated by a moisture eliminator, see Figure 6. The gas then passes to electrostatic precipitators for final cleaning. The gas for the dust tests, which were made by the standard paper thimble method, was sampled from the stream just below the moisture eliminator where the gas was relatively free from entrained moisture. Inlet samples were taken just ahead of the venturi section. See Figure 6.

RESULTS—PLANT SCALE VENTURI WASHER

The operation of the plant-scale venturi washer has been entirely satisfactory; it has performed well and has required no maintenance.

The design of the venturi was predicated on a gas flow rate of 85,000 cfm and a desired pressure drop of about 20 in. of water. The area and water ratio chosen on the basis of Figure 5 were 5.33 sq ft and 3.3 gal per thousand cu ft, respectively, and the predicted dirt content of the cleaned gas was 0.024 gr per cu ft. As it turned out, the gas flow rate has been close to 76,000 cfm, considerably lower than that on which the design was based, and the water flow was increased over a period of time to about 11 gal per thousand cu ft of gas. About two-thirds of the water is delivered to the inclined nozzles at a pressure of about 38 psi and one-

third to the horizontal nozzles at a pressure of about 10 psi. Under these conditions the loss in gas pressure is about 28 in. of water and the dirt content of the washed gas averages less than 0.02 gr per cu ft.

These conditions are outside the range covered in the operation of the pilot plant venturi, and the results are not consistent with extrapolation of the applicable curves of Figure 5. Pressure loss depends on things other than gas velocity through the throat and water ratio, and Figure 5 should be used merely as a guide for shapes and sizes other than the 18-in. diam venturi to which Figure 5 applies. Figure 5, however, does show that pressure loss can be increased by increasing either gas velocity in the throat or water ratio. The gas velocity in the present washer was lower than the design figure, and good gas cleaning was obtained by increasing the water ratio. In general, however, we feel that it is preferable to operate at a higher gas velocity and consequently to use less water, and we can see no reason why good gas cleaning cannot be obtained with a water consumption of about 5 gal per thousand cu ft of gas, or possibly less.

The venturi section was lined with the same type of fused cast refractory as used in the pilot plant unit, as shown in Figure 7; concrete was again used to fill in around the nozzles in the throat. Inspection of the lining of the venturi, after two years of operation, shows negligible wear of the cast refractory blocks and only a slight amount of erosion of the concrete at the two ends of the throat where there were no water nozzles. Along the sides of the throat where the nozzles were located, there was negligible erosion of the concrete. No maintenance time, other than the routine cleaning of the water nozzles and repacking of pumps, has been required during the two years' operation of the plant scale venturi washer.

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U.S. Patent No. 2,604,185.

DISCUSSION

PRESENTED BY

N. C. CORNELIUS, Staff Engineer — Raw Materials, Coke Ovens and Blast Furnaces, Jones and Laughlin Steel Corp., Pittsburgh, Pa.

J. E. EBERHARDT, Division Head, Research Dept., Bethlehem Steel Co., Bethlehem, Pa.

JAY J. SEAVER, Manager, Jay J. Seaver Engineers, Chicago, Ill.

A. W. ANTHONY, President, Pease, Anthony Equipment Co., Newtonville, Mass.

HARRY RICHARDSON, District Manager, Research-Cottrell, Inc., Pittsburgh, Pa.

N. C. Cornelius: What is the gas temperature and the moisture content on the outlet side of the venturi washer, and on the outlet side of the cooling tower?

Dr. J. E. Eberhardt: About 125 F saturated. Temperature on outlet side depends on the design of the cooling tower. It can be made as cool as you like, depending on the water temperature. This particular tower was designed for about a five-degree approach.

N. C. Cornelius: What is the size of the cooling tower, the diameter and height?

Dr. J. E. Eberhardt: This particular one is undersized; we are troubled with entrainment. I suspect that the diameter should be about 14 ft for 85,000 cfm.

N. C. Cornelius: What is the gas cleanliness after the cooling tower?

Dr. J. E. Eberhardt: That was where the tests were made. We made a great many measurements of the dirt content of the water leaving the cooling tower, and the dirt picked up in the water or removed from the gas in the cooling tower is nil. The separator below the venturi does a very good job of eliminating the entrained dirty water carried down from the throat by gas, so the cleaning is done in the venturi. That water, then, contains substantially all the dirt removed and is kept separate from the water used in the cooling tower. The water used in the cooling tower picks up substantially no dirt and is discharged to the sewer.

N. C. Cornelius: In your paper you mentioned the use of raw water. Is this raw water cleaned?

Dr. J. E. Eberhardt: There are some basket strainers with $\frac{3}{16}$-in. openings.

N. C. Cornelius: Are there other strainers or filters in the line?

Dr. J. E. Eberhardt: No.

N. C. Cornelius: Was the elimination of the packing or wood hurdles in the plant scale cooling tower predicated on a cleaner gas discharge from the venturi washer since the venturi area was changed from circular to rectangular?

Dr. J. E. Eberhardt: We left them out because the superintendent does not like wood hurdles.

N. C. Cornelius: What is the combined water rate, that is, for both venturi washer and cooling tower?

Dr. J. E. Eberhardt: Again, I can not answer that directly. You need about five gal of water in the venturi washer per thousand feet of gas. Then somebody has to decide how cool the gas should be and that determines the water requirement for cooling.

N. C. Cornelius: What is the basic construction of the moisture eliminator (after the cooling tower)?

Dr. J. E. Eberhardt: Refer to Figure 6. There are two eliminators, the one we call a separator is nothing more or less than a large pipe and a smaller one arranged so that the direction of gas flow is reversed. This has been sufficient to eliminate substantially all of the dirty water. The eliminator after the cooling tower has a corebuster in the middle and spiral vanes. This is a design used around coke ovens for many years. There are a half dozen different types of moisture eliminators. In this case, the gas is clean and the entrained moisture is clean, so a relatively elaborate one can be used.

N. C. Cornelius: Would you care to discuss in approximate figures the cost of the plant scale system as compared to purchasing a conventional type gas washer?

Dr. J. E. Eberhardt: The first one we built cost a lot of money but there are a lot of other things in it besides the venturi washer. From the looks of it, I am sure it would be competitive with most primary washers.

N. C. Cornelius: I should like to commend the authors on the presentation of a very interesting subject. Those of us specifically assigned to duty in blast furnace operation and design can appreciate the importance and value of gas cleaning.

Jay J. Seaver: The paper on cleaning blast furnace gas by the venturi method presents a new approach and novel idea for cleaning blast furnace gas.

It outlines many advantages which are accomplished by using this method. These are small space required, small capital investment, no moving parts, low maintenance cost, easy to inspect, minimum water requirements, minimum thickener requirements, reasonable pressure drop and high cleanliness for a secondary washer cleaner.

Water pressure required at the nozzles is from 40 to 60 psi, as against 10 psi pressure required in an ordinary gas washer.

It is interesting to note that one of the big troubles in the ordinary cylinder gas washers is to keep the water nozzles clean and working. In the venturi plant washer a cleaning reamer is provided in each nozzle, so that the nozzles can be cleaned from the outside platform in a short time.

The venturi area required is about 0.6 sq ft per 1000 cfm of gas cleaned, whereas in a standard cylinder gas washer an area of 3 sq ft is required per 1000 cfm of gas cleaned.

It is reasonable to expect that this type of venturi gas cleaner, with its many advantages, will have serious consideration by those having future gas cleaning requirements.

A. W. Anthony: I will not try to add anything to the excellent technical report by the authors who have covered very well Bethlehem's investigation and first plant scale unit for cleaning blast furnace gas. I take pleasure in taking off my hat to the authors, with whom I have worked closely, and to their employer, for ability and courage in carrying through this program.

This application of the principles of the venturi scrubber is just one out of about 35, in many differing industries, with about 150 units operating on about 1,500,000 cfm rated capacity; four are on blast furnace gas, some 28 on about 400,000 cfm of gases containing sulphuric and phosphoric acid mists; some 30 smaller units recover valuable amines from tail gases from CO_2 plants. Reports from users have been good: high efficiencies, simple, trouble-free, low maintenance; repeat orders have been gratifying.

Harry Richardson: The statement was made that all the gas was taken from the venturi gas main. Was that after the primary washing and what was the dust content of it?

Dr. J. E. Eberhardt: Both in the plant scale and the pilot plant the gas was taken directly from the dry dust catcher. Content varies so much from time to time (we get anything from 3 to 50 gr per cu ft) that we rely only on the dirt contained in the cleaned gas. The inlet loadings are interesting if it is desired to calculate efficiency, but efficiency is not too meaningful in this application.

AISE SPRING CONFERENCE

APRIL 25, 26, 27, 1955

HOTEL STATLER DETROIT, MICH.

Symposium on Annealing Furnaces

. . . . many developments have occurred in annealing since the war . . . . continuous annealing has advantages for high production plants; single stack coil annealing offers benefits in smaller plants . . . .

"DESCRIPTION OF BATCH AND PORTABLE ANNEALING FURNACES FOR COILED STRIP"

By H. B. HELM
Fuel Engineer
Youngstown Sheet and Tube Co.
East Chicago, Ind.

▲ SINCE the tin annealing and sheet annealing are somewhat different operations at the Indiana Harbor Works, they will be described separately.

TIN ANNEALING

The equipment for annealing tin plate consists of 36 stationary batch type in-and-out furnaces built during the period 1931-38. They are direct fired with coke oven gas. These are divided into two groups. One group of 24 furnaces are each 8½ ft wide by 22½ ft long, by 9½ ft high. The combustion equipment consists essentially of two drilled pipe burners along each side of the charge. Each burner is a pipe within a pipe—the inside pipe carries the fuel and the outside pipe the air.

All furnaces are equipped with temperature control. Fuel-air ratio is maintained by use of combination air gas valves. The temperature control is of dual control type in which the controlling temperature is an average between roof and one work couple. Additional work couples are recorded only. The maximum charge is 4 stacks, each piled three high with 33 in. wide strip coiled 42 in. in diameter for a total of 70 tons. A charge of 55 to 60 tons (80 per cent loading) is usually in the furnace for approximately 42 hours giving a tons per furnace hour of 1.35. Obviously with smaller size charges, the tons per hour drop, being around one ton per hour with an average charge of 39 tons.

The remaining 12 furnaces are somewhat larger but of similar design. Each of these furnaces is 13½ ft wide by 26 ft long by 11 ft high. Piling height is 76 in. Maximum capacity is 8 stacks each being piled 3-high with coils 42 in. in diameter by 25 in. wide—a total load of 100 tons. However, the majority of material annealed is 29 in. wide or greater, hence can be piled only 2-high. Type of combustion equipment and fuel are similar to the 4-stack furnaces just described, but differ in that each furnace is divided into a front and rear zone for control purposes, each zone having its own temperature control, ratio valves, and burners. With an average charge of 77 tons, the time in the furnace is about 40 hours. Tons per furnace hour for this type charge is 1.9. With an average loading of only 65 per cent tons per hour drop to around 1.62.

Inner covers are all plain mild steel and have a life of around 150 heats.

A protective atmosphere is supplied all furnaces by two 20,000-cfh gas generators. Normal fuel for these generators is natural gas. However, they are equipped to burn coke gas if at any time this is necessary. Atmosphere delivered to the annealing department is essentially nitrogen with 5 or 6 per cent hydrogen.

SHEET ANNEALING

The new sheet annealing facilities recently completed are housed in a building 912 ft long x 135 ft wide. The equipment includes 14 radiant tube fired portable coil annealing furnaces and four radiant tube fired furnaces for annealing flat sheets. The flat sheet furnaces have not been operated long enough to obtain any conclusive data.

The coil annealing furnaces are 8 ft-1 in. wide by 34 ft-8 in. long and 14 ft-3 in. high. Each furnace is capable of handling 4 stacks of 72 in. coils piled 156 in. high—a maximum charge of 300 tons or 75 tons per stack. Each furnace is heated by 25 radiant tubes arranged in 5 banks of 5 tubes each. The tube banks are located at each end of the furnace and between the four stacks. They are spaced approximately two feet apart vertically.

Base to furnace ratio is 3 to 1 making a total of 42 bases. Each base is equipped with 4 recirculating paddle type fans driven by 15-hp motors at 1750 rpm.

Combustion air is supplied by four centrally located blowers which deliver air at 40 oz. pressure. The air is piped to all bases where it can be connected to the furnace in the conventional manner. Coke gas at 4 psi is delivered to each base in the same manner. The gas and air are mixed in carburetors located on the top of each furnace. Mixture pressure varies from 30 to 35 oz. The waste gases are collected in a manifold on the furnace and exhausted to the atmosphere by means of a fan.

Thermocouples are located in the base of each stack and one in the furnace. Temperature control is the switch-over type in which furnace temperature is the controlling medium until the work reaches a predetermined point at which the control switches over to the work.

Convector plates are used between the coils to improve heating rate.

At present it is the practice to use an orifice on the top coil in order to reduce sand pickup by the recirculation of the atmosphere under the cover. This orifice also tends to build up a differential between the outside and inside of the coil to help pass the atmosphere through the convector plates. Inner covers are similar to those used in the tin mill being plain mild steel. The furnaces have not been operated long enough to determine cover life.

With less than six months' experience with this type furnace coupled with the problems encountered in starting up new facilities, it is obvious that our operating practices are still in what might be called the experimental stage.

Unfortunately, as in the case of the flat sheet annealing furnaces, the coil furnaces have not been in operation long enough to collect any dependable data on performance.

"QUALITY COMPARISON OF BOX VS STRIP ANNEALING OF TIN MILL PRODUCTS"

By W. H. SWISSHELM
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Tin Plate Dept.
Inland Steel Co.
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Radiant Tube Annealing of Tin Mill Products—Radiant tube annealing of tin mill products in the most modern installations, starts with a precleaned 66 to 72-in. outside diameter coil. Each of the annealing bases will have four, six or eight circular hearths with circulating fans in each hearth, rated up to 15 hp. Usually 4 coils are piled on each hearth with a convector plate between each coil or at least in the two lower positions. Orifice plates are often used on the top coil.

A cylindrical cover, either of mild steel or corrugated stainless, is placed over each hearth and sealed with sand. Air is purged from the inner cover with a non-oxidizing atmosphere after which the radiant tube furnace is lowered over the entire base and firing begins. The charge is brought up to the range of 1150 to 1250 F steel temperature depending on temper required, soaked out for a 4 to 8-hr period to assure uniformity, and the furnace is then removed to another base holding a previously prepared charge. Firing rates of 8 tons per hr can be reached with ideal coil sizes and an average rate of 6 tons per hr is reported by one producer.

After removing the furnace, the charge is cooled as rapidly as possible to below 300 F, at which time the inner covers can be removed and the charge broken down. Approximately 48 additional hours are required to cool the coils to a temperature suitable for temper rolling, for a total elapsed time of about 160 hrs.

Auxiliary equipment consists of atmosphere generators, forced air ventilation of the entire building to insure a good cooling rate, and a heavy duty overhead crane.

Continuous Annealing of Tin Mill Products—Continuous annealing of tin mill products usually includes cleaning as an integral part of the operation, therefore, it starts with a cold reduced coil directly from the five-stand tandem mill.

The entry end of the line is designed to handle 30,000-lb, 72-in. outside diameter coils. There are alternate pay-off reels, a scrap reel, double-cut shear, four-seam welder with crop shear, No. 1 tension bridle, and a looping tower containing 580 ft of usable strip.

From the tower, strip enters the cleaning section of the line. The cleaner is vertical with an immersion time of 4 seconds in 4 oz per gal sodium orthosilicate at 190 F. The cleaning tank is followed by a hot water (200 F) rinse.

After drying, strip goes through the No. 2 tension bridle, then over a dancer roll by means of which the required strip tension is maintained through the heating and cooling sections.

The strip then enters a pre-heating duct through which the products of combustion are counter flowed against strip travel. This is a single vertical pass of approximately 50 ft which raises strip temperature to about 400 F.

The heating section proper consists of a single vertical pass through a radiant cup furnace approximately 50 ft high. There are 264 six-in. cups disposed on two parallel walls 8 in. from the strip pass line. The strip temperature is increased from 400 F up to 1300 F in about 4 seconds.

From the heating section, the strip enters a refractory lined slow cool in which it makes four vertical passes. Temperature drops from 1300 F down to 1200 F in about 15 seconds. It then enters the fast cool section where temperature is reduced to 550 F in another six passes. The last fast cool chute is directly over a water quench tank in which the final cooling down to 120 F is accomplished in one second.

Following the quench tank the strip is dried, then goes through No. 4 tension bridle, the delivery looping tower containing 580 ft of usable strip, No. 5 tension bridle and to one of two tension reels.

For the mill operator, the first essential in a quality

comparison is the actual physical condition of the products. In the production of tin mill products the strip, following annealing, is almost always temper rolled. Modern temper mills operate at speeds up to 6000 fpm, and to achieve the production possible with such a mill speed, requires an exceptionally good piece of strip. Inland's new radiant tube annealing department is laid out so that all material movement from cold reduction to temper rolling will be by conveyor, with the exception of the actual anneal charge buildings and breaking down. This means the coils will be crane handled two or three times, which is quite an improvement over present practice which requires at least six lifts and often more.

In contrast, the strip anneal operation requires no handling of the coil on its edges at all. The up-ending and down-ending operations are eliminated, and all movements can be effected with ram tractors, which insures the absolute minimum of physical damage. Stickers on box annealed steel have always been a problem for temper mill operators. Stickers can cause very serious drops in both productivity and yield. They can be caused by a variety of things, chief among which are: (a) uneven winding at cleaning line, (b) tight winding at cleaning line, (c) poor shape in the tandem rolled steel (ridges or heavy buckle), (d) handling damage, and (e) localized or general overheating.

A strip annealing line cannot make a sticker. Stickers are the result of two or more coil laps being pressed tightly together while at an elevated temperature with an actual weld forming in extreme cases. Since the strip anneal exposes only a single strand to the high temperature at a time, it is impossible for sticking to occur.

Another common defect associated with box annealing is sand spots. This defect originates with grains of sand from the sand seals being caught between the wraps of a coil and being pulverized during subsequent temper rolling. This is especially difficult to prevent when using the modern high power recirculating base fans. Obviously, since sand seals are eliminated no sand spots can occur on a strip annealed product.

Conversely, there are some defects originating with a strip anneal line that are unknown to producers who only box anneal. One of these is dimples caused by pick-up of scale or other foreign matter on the rolls in the high temperature zones. Light dimples are produced almost continuously, but these are eliminated by temper rolling with no ill-effects. When they become heavy, temper rolling does not eradicate them completely, and this can be a cause for rejection. The other major defect peculiar to strip annealing is heat buckle. This defect is characterized by a severely buckled region, usually only 3 to 4 in. in width, running longitudinally down the center of the strip. The cause of this is too much tension for the operating temperature and section being run. This defect can be extremely serious. It may cause a broken strip on the line, damaged temper mill rolls, or, at least, loss in productivity at the mill.

The normal absence of strip defects in the strip anneal product results in a 10 to 50 per cent increase in temper mill productivity over normal box annealed steel.

One additional advantage enjoyed by strip anneal operators is the improvement in strip shape generally noted in passing through the line. The combination of tension, although light, and the elevated temperatures tend to pull out many variations in shape that box annealing would not affect.

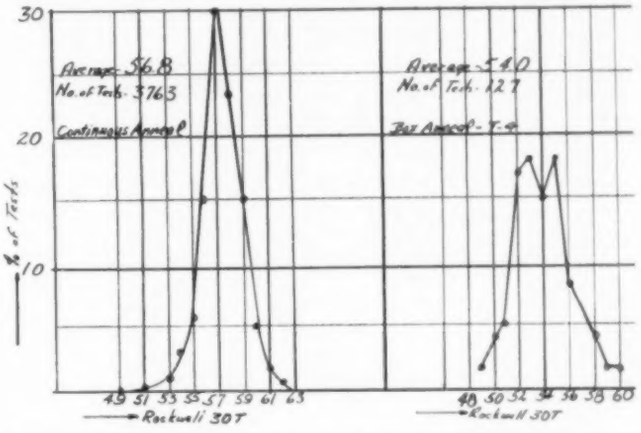


Figure 1 — Charts give a comparison of hardness uniformity for continuous anneal product on the left and box anneal T-4 on the right.

The comparison of physical properties is illustrated by Table I and Figure 1. These comparisons are of a similar analysis of mechanically capped steel, the box anneal material having been annealed according to T-4 practice. Note that both the *as* annealed hardness and finished tinplate hardness of the continuous anneal material is approximately 3 points above the box anneal. However, the hardness uniformity of the strip anneal material is much superior to that of the box anneal.

Table II illustrates most conclusively one of the outstandingly good characteristics of the continuous an-

TABLE I

Physical Property Comparison
Continuous Anneal vs Box Anneal
Rockwell 30T Scale

	Continuous anneal	Box anneal (T-4)
As annealed	56.8	54.0
After tinning	64.0	61.0

TABLE II

Corrosion Resistance Comparison*
Continuous Anneal vs Box Anneal

	Continuous anneal			Box anneal		
Iron solution test (πϕ), average for 100 samples	10			83		
	Edge	Center	Edge	Edge	Center	Edge
Pickle lag (sec), average for 50 samples	10	6	10	59	35	57

* American Can Co. — Grade A specification.
No. 1 — Low pickle lag value 10 sec or less must be maintained.
No. 2 — Low iron solution test values under 20 together with demonstrated pack comparable to material tinned on alkaline electrolytic line using an inhibited pickle.

neal product. This table shows a comparison of the corrosion resistance factors that are required to meet the American Can Co. Grade A specification. Note that the iron solution maximum value of 20 is easily met by the continuous anneal product while the box anneal material has an average value of 83.

The pickle lag values are equally outstanding. The specification calls for a maximum of 10 seconds which the continuous anneal material meets, while the box anneal product has center test of 35 seconds and the edges are 59 and 57 seconds.

"SINGLE STACK COIL ANNEALING"

By W. F. CARTER*

Assistant General Superintendent

Acme Steel Co.

Chicago, Ill.

▲ IT is the purpose of this paper to relate briefly and to discuss operating experiences at Acme Steel Co.'s strip mill at Riverdale with modern, single-stack, high convection, radiant tube coil annealing furnaces, and to compare it to experience with equipment previously available at our mill. It is not the purpose of this paper to compare the furnaces nor their performance with other modern types of equipment.

Historically, Acme Steel Co. entered the strip steel business in the middle twenties, and has been a producer of high quality strip steel for approximately 30 years. The equipment initially installed and employed for annealing consisted of five coal-fired "box" type furnaces. These were later modified to burn producer, then finally natural gas, and additional furnaces of the same general type were installed until a total of 16 was reached, with an annual capacity of approximately 72,000 tons of low carbon deep drawing steel.

Figure 1 shows a box in position to be charged into the heating furnace. The overall dimensions of the unit shown are approximately 22 ft long x 92 in. wide, x 83

*Deceased.

Figure 1 — The first equipment was composed of five coal-fired box furnaces.

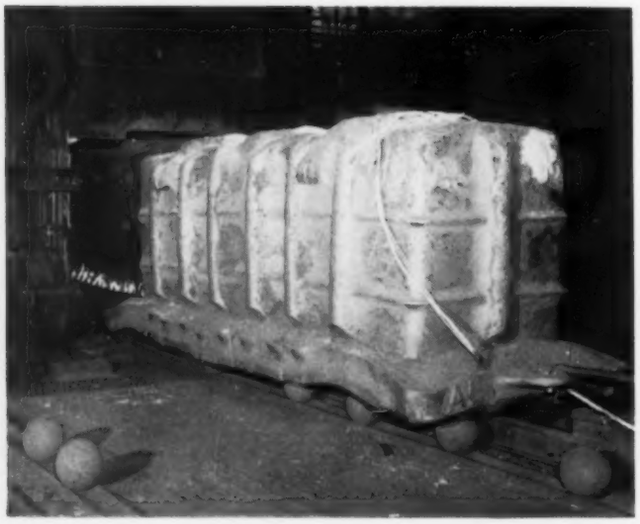


Figure 2 — Single stack radiant tube units of 36,000 tons annual capacity were installed in 1953.

in. high. The total weight of such units with a charge averages approximately 31 tons with a charge weight of only 19 tons. The usual heating cycle averages approximately 32 hours. This amounts to a production of approximately 0.6 ton per furnace hour. When a cooling cycle for the boxes of 72 to 90 hours is added, depending upon the atmospheric temperature, a floor to floor cycle of 104 to 122 hours is obtained. The cooling rate therefore varies between approximately 0.2 up to approximately 0.25 tons per hour. In mid-summer during periods of high production when it is necessary to crowd the boxes in the cooling area, cycles of 5 days (floor to floor) are common. The gas consumption on this furnace runs approximately 2,200,000 Btu per ton of coils annealed. This high consumption is due of course to the relatively inefficient combustion obtained in these furnaces and the necessity for heating approximately 12 tons of cast steel, base and cover for each 19 tons of coils annealed.

Note also the sand seal which is used on the annealing base shown. Those in attendance which have operated such equipment are familiar with the difficulties which can and do arise from the failure of such seals, as well as the "housekeeping" problems generated by the presence of sand in the annealing department, and the problems that can be encountered in the subsequent operations as the result of sand becoming entrapped in the coils and being unintentionally transported to the subsequent operations.

While this equipment served to produce many thousands of tons of serviceable steel over a period of many years, its performance from the quality point of view and its productivity became increasingly inadequate during the 1940's and the addition of more modern equipment became imperative.

A study of Acme's requirements were made during the late 1940's with the result that additional equipment of the single stack, radiant tube type with an annual capacity of approximately 36,000 tons was purchased and placed in operation early in 1951. The second addition of 36,000 tons annual capacity was placed in operation in mid-1953.

Figure 2 is a general view of the complete installation

Figure 3 — Shape of curved vanes in compensating convectors adjusts for the use of radiant heat in the outer wraps of the coil.

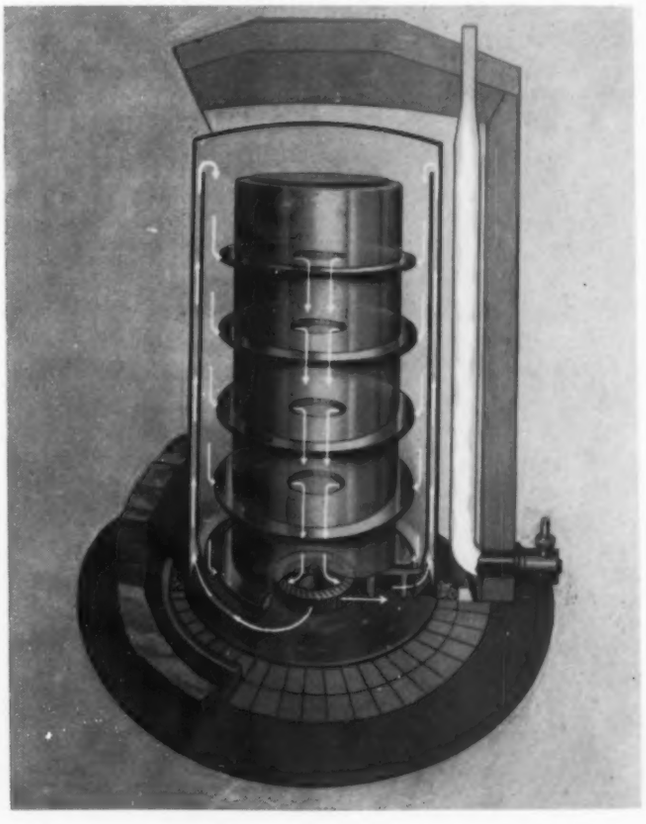
which consist of 16 stools or bases and 7 furnaces for annealing 25-ton charges of 48-in. diameter coils stacked to a maximum 120-in. height. This particular equipment was selected after a careful study of all available types, because it provided many features which are important to a mill which produces quality strip steel items in a wide variety of chemistry, widths, gages, and finishes, and where quantities ordered very frequently run as low as a few hundred pounds.

More important of these features are these: the single stack charge and the circular furnaces provide maximum surface area per ton of steel in the charge with the result that a high rate of heating may be safely attained. This, of course, results in shorter cycles. Equal spacing of radiant tubes about the charge provides for uniform heat transfer to all parts of the charge. This design also incorporates an oil seal which provides positive trouble-free sealing of the protective atmosphere and eliminates the other problems previously caused by sand. Other important features of the design are the large capacity recirculating fans and separators or convector plates which jointly provide for controlled flow of the gases around and between the charge, and which promotes higher heating and cooling rates and better temperature uniformity throughout the charge. These high heating and cooling rates result in very short cycle times (floor to floor), which is an important matter during competitive times when the difference of a few days in delivery promise may very well determine to whom the order is given.

These features can best be understood by referring to Figures 3, 4, 5 and 6. Figure 3 is a separator or convector plate. Note the ribs which support the coils and form ducts for controlling gas flow over the coil edges. The total thickness of these plates is $1\frac{1}{2}$ in. It has been our experience that these convector or separator plates are very effective in reducing the heating and the cooling time. Figure 4 shows a complete charge on a stool with a convector plate between each coil. On narrow widths, each coil obviously cannot be separated from its neighbor by a convector plate because the space taken up by the convectors becomes excessive and charges might suffer seriously. The practice on narrow

Figure 4 — Stack of steel coils shows convector locations.

Figure 5 — The principle of the radiant convector furnace is shown in this sketch. Arrows indicate flow.



width material is to use a convector plate at 12 to 18-in. intervals.

Figure 5 is a diagram of the controlled gas flow obtained by use of the fan, convector plate, and the "sleeve" or inner liner.

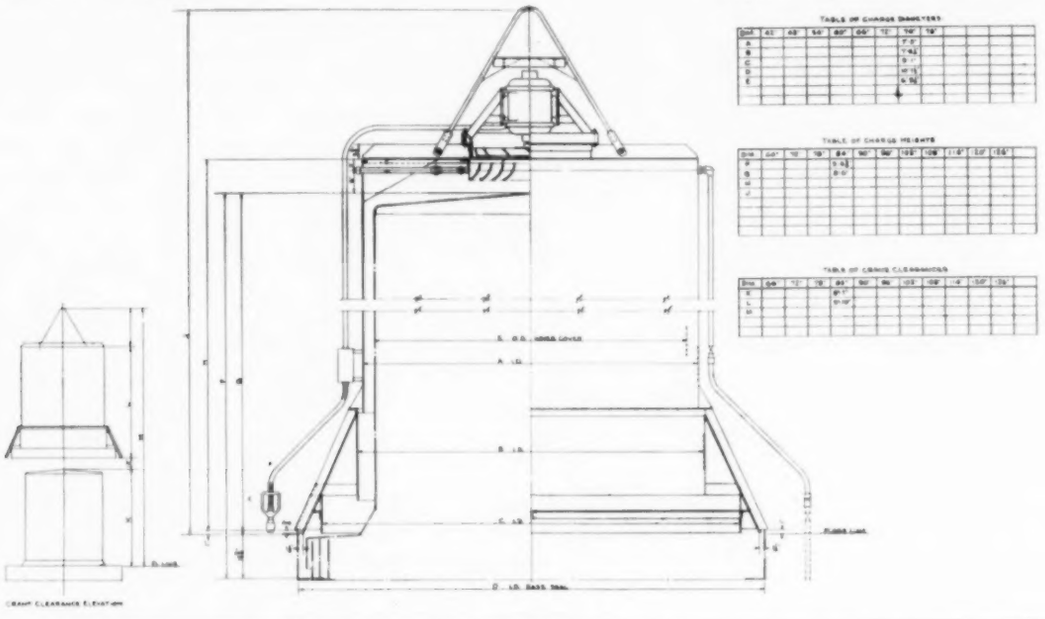


Figure 6— Forced cooler uses air and water sprays to shorten cooling cycle.

Figure 6 is a drawing of a cooling cover which is employed to accelerate the cooling of the charge after annealing. After the removal of the furnace, this cover is placed over the charge and annealing cover. It provides accelerated cooling by forcing air from the fan shown at the top along the side of the annealing cover until a temperature of approximately 500 F is attained, where the cooling is further accelerated by the addition of a water spray applied to the top of the annealing cover.

Table I shows the results obtained when annealing maximum diameter coils, but with a charge weight below maximum because of a low piling height. Note that the heating rate is approximately 2½ times the heating rate of the old box type furnaces (1.56 tons per hr vs 0.6 tons per hr), and the cooling rate is approximately 4 times that of the old furnaces (0.95 tons per hr vs 0.225 tons per hr). Unfortunately, this type of charge is not very common in our strip mill. Most charges are made up of coils of various widths and diameters with a resulting loss in capacity. Under average conditions, our charges are approximately 38,000 lb and the production then averages approximately 1.3 tons per furnace hr. This rate applies to the annealing of low carbon deep drawing steel when using a soaking period of 3 hr after the thermocouple in the bottom of the furnace reaches 1250 F. When using this practice, the gas consumption is approximately 900,000 Btu per ton. This consumption is approximately 40 per cent of that experienced with the old furnaces.

Figure 7 plots the weekly average rates of cooling and heating with average charge size when annealing high carbon steel to a pearlitic structure. This data was prepared originally to show the effect of the number of combustion tubes on the performance of the furnace. The data on the left was collected while operating three six-tube furnaces (those first installed) and one nine-tube furnace which was purchased later to provide additional capacity when annealing high carbon steel. The data on the right hand side of the figure was collected after converting the three original furnaces from six to nine tubes and after placing into operation the second addition of furnaces which were of nine tube. Note that the production rate increased from an average of 1.05 tons per furnace hour to an average rate of 1.15 tons per furnace hour, or approximately 10 per cent. Since the charge size remained almost constant, see the lower portion of figure, the increased production is obviously due to a decrease in heating time. It is interesting to note that the cooling time (top of figure) increased with the use of nine-tube furnaces. This has been interpreted to be an indication that more uniform heating has resulted from the use of nine tubes. This is probably true since no changes were made in the cooling conditions and is therefore due to the total heat content or the charge being somewhat higher than under previous heating conditions. It is interesting to note the effect of charge size on both the heating and cooling rates as expressed in tons per hour. The form of the curves are almost identical and indicate a high degree of correlation between charge size and production. This, of course, is not a new discovery and is interesting only because it is an additional study and adds to the information already available.

Figure 8 plots the results obtained during the same period of time covered by Figure 7 when using a subcritical spheroidizing annealing cycle with a long soak period. Changes in equipment from three six-tube and

TABLE I

Low Carbon Anneal

Coil size (approx)	
Inside diam — 16 in.	
Outside diam — 48 in.	
Width — 16.5 in.	
Weight — 7160 lb (average)	
Number of coils per furnace charge	6
Average weight per furnace charge	43,000 lb
Average tons per hour of heating	1.56
Average tons per hour of cooling	0.95

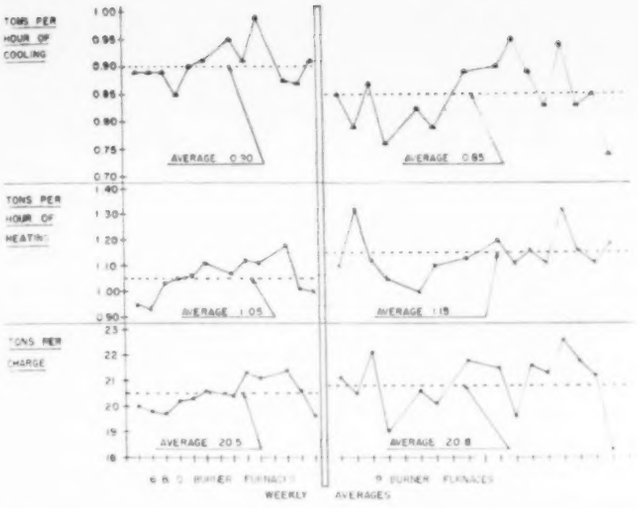


Figure 7 — Chart shows average rates of cooling and heating when annealing high carbon steel to a pearlitic structure.

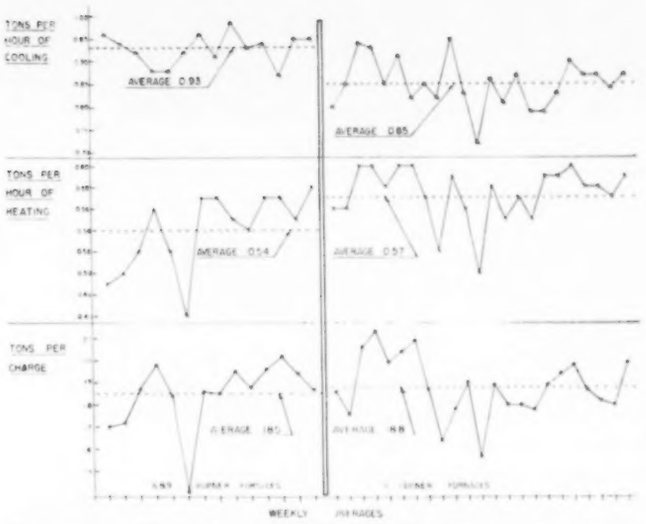


Figure 8 — Chart shows average rates of cooling and heating when annealing high carbon steel to a spheroidal structure.

one nine-tube furnace to furnaces employing 9 tubes has again resulted in an increased production. In this instance, it is of smaller magnitude because of the effect of a long soaking period which remains the same during each period of time as well as a lower maximum furnace temperature which is used to avoid over-heating. The effect of charge size upon the heating and cooling rates is again expressed in tons per hour.

"CONTINUOUS ANNEALING"

By JOHN SOYRING

General Foreman, Annealing

Tin Mill Cold Reduction Dept.

United States Steel Corp.

Gary Sheet and Tin Mill

Gary, Ind.

▲ IN the processing of light gage steel for the various types of coated tin plate or uncoated black plate, the annealing or heat treating operation, in most plants, is the longest time consuming operation. In most plants, a coil is delayed in the production schedule from four to seven days, depending on the size and type of annealing furnace used. At the present time, there are at least five types of batch coil annealing furnaces used by the various tin plate producing units. In addition, various continuous type annealing furnaces are in use. At Gary Sheet and Tin Mill, there are both the batch type and the continuous type annealing equipment. The present as well as the future improvements in batch annealing operations will include not only the heating cycle, but also, the cooling cycle which in the past had been taken into consideration only by the addition of another base or floor area for cooling annealed coils.

At Gary Sheet and Tin Mill there is a continuous strip annealing line, which accomplishes three separate operations; namely, cleaning, annealing, and cooling of "cold reduced only" strip. The line has been engineered to produce thirty tons per hour of clean, bright and uniformly annealed strip of various widths and thicknesses. At the present time the annealed coils weigh about 12,000 lb each and widths vary from 24¾ to 35½ in. and thickness from 0.0083 to 0.0147 in.

The various separate units of equipment consist of the cleaning or the entry section, the heating section and the cooling or exit section of this line.

The cleaning section comprises the conventional strip processing pay-off equipment such as entry end coil cars, two expanding mandrel type pay-off reels, double wheel seam welder with the required pinch rolls, and shear. The pay-off reels, coil hoists, and coil cars are designed to handle 30,000-lb maximum coils with an outside diameter of 66 in. In order to make satisfactory seam welds, line speed is slowed to 450 fpm. The seam welding itself takes approximately 14 seconds.

In order that the strip surface will be free of contamination from the rolling solutions or oils before it is annealed, the strip must be cleaned. This is accomplished in six vertical, twelve-ft passes in an alkaline solution which is controlled at a temperature of about 190 to 200 F with a solution strength of 2½ or less ounces of orthosilicate per gallon of water. On the Gary unit, four of the six passes use electrolytic action. The power for the electrolytic action is furnished by two 24-volt, 7500-amp generators, and the current flow is reversed every time the seam welder makes a weld. There are several features about the cleaner that assist in making a clean strip prior to annealing. The solution is continuously recirculated and the counter-flow cascading system in the cleaner tanks has very definite benefits. Since this cleaning is basically a washing operation, the results are accomplished with the aid of the electrolytic action helping to free the surface oils and then the caustic solution forming a soap type solid. This dirty solution, overflowing into the storage tank in the basement, separates in suspension. Some of the contaminants enter the bottom of the storage tank. About twice the amount of solution that is required to fill the electro-

lytic cleaner tank is carried and in this way the flow rate is slow enough for the solid contaminants to settle. The intake outlet for the recirculating solution pumps is high enough from the bottom of the storage tank so the solid material will not be recirculated if the tank is cleaned out every week or ten days. In the electrolytic cleaner tank, the sink rolls are above the bottom of the tank and are far enough to keep the strip free of the solids. During strip breaks in the cleaner section, clean water flushing of the tanks is done to keep the solid contaminants fairly well washed out from the bottom of these tanks.

After the washing operation, the strip goes through a scrubber unit. Two nylon brushes are used on each side of the strip. The best arrangement of brushes would be to back up each brush with a steel roll instead of a single large steel roll backing up two brushes. The tip speed of the nylon brushes is about nine times the top strip speed which tends to give a much better brushing action to the surface of the strip. Clean warm water is sprayed onto the brushes to keep the brushes as free as posible from any cleaner solution. Volume of water flow is important in this unit, and adequate draining must be maintained in order to avoid the brushes re-depositing cleaner solution. After this scrubbing, the strip goes into a hot water rinse. Here the strip goes through about a 12-ft vertical dip rinse in water at 200 F and finally through a hot water spray. After a wringer roll, just above the hot water sprays, the strip goes through a hot air blast that dries the strip.

In order that the strip can be maintained in continuous movement through the furnace section of the line while the cleaner section is stopped for the welding of two coil ends, there is a storage section in the line. This is a free, loop type storage and amounts to about 400 ft of strip in three separate loops. The amount of strip in each loop is controlled by photo-electric cells that will speed up or slow down the strip from this point to the pay-off reel. At higher speeds, there is a certain amount of twisting present in the long loops that can be controlled with the help of drag magnets. This twisting motion will tend to cause the strip to climb out of the entry guides ahead of the pinch rolls and cause strip breaks or damaged edges. From this storage, the strip travels through tension bridles and through a back tension regulator and over a split self-aligning centering roll before entering the annealing furnace vertically.

The furnace section of this line consists of the heating and holding zones which are vertical passes of about 51 ft in length. The strip is heated in six passes by 107 radiant "W" shape alloy tubes arranged in seven vertical rows. These 107 heating elements are grouped into six controlled firing zones. The firing control is an "on" or "off" control, and our fuel is coke oven gas.

The burner or "firing leg" is the top tube of the vertical "W" shape 25-12 alloy tube. The products of combustion are drawn through the tube by an eductor system. The eductors are set to give a negative pressure inside the heating tube at all times so the pre-mix gas and air pilot lights can be kept burning and exhausting all the time. The combustion air for the burner is drawn in around the bottom of the exhausting leg of the tube to the eductor header. When a zone is to open for firing, the eductor opens for the zone, increasing the negative pressure inside the radiant tube so as to pull in combustion air just before the coke oven gas valve is opened to the burner. Since the combustion air is drawn in around the exhaust leg of the tube, we obtain 400 to 500 F pre-heat in the air to the burners which is a big factor in our fuel economy. Fuel consumption varies from as low as 700,000 to 775,000 Btu's per ton which is a very good figure for heating steel. This type of heating system has a definite advantage since, when there is a tube failure in the form of a hole or crack, there will be very little chance of the products of combustion getting into the furnace atmosphere to cause surface conditions on the annealed strip that will cause some trouble in coating operations. One disadvantage of this type of heating is that the radiant tube is subjected to hard usage since the burner fires wide open or closed instead of a constant firing. Another source of trouble with this type of a system is that there is a constant loss of atmosphere gas when there are any fractured tubes in the furnace.

The strip temperature reaches the annealing range in the third to fourth pass of the furnace. To reach this temperature at a 30-ton per hour rate, the furnace temperatures are maintained at approximately 1600 to 1675 F, and the exit strip temperature runs about 1200 F as it enters the electrically heated holding zone of the furnace. This zone also has six vertical passes of about 51 ft each. The heat for "soaking" or holding the strip temperature is furnished by electrical heating elements suspended by alloy pins on each of the four side walls of the unit. The power input is small because of the well insulated construction of this zone, and also because the strip temperature leaving this zone is about 40 F lower than it enters. From the holding zone the strip enters the cooling section of the line.

The cooling section of the line is made up of four separate zones; namely, the slow cool, the fast cool, the air blast tower, and the exit end with its storage loops, dual back tension bridles, shear, two winding reels and the necessary coil discharge equipment. Controlled slow cooling of the annealed strip to around 850 F is accomplished by two passes provided with pipes through which air is blown. The fast cool zone consists of 20 vertical passes with water jackets. This type of cooling is effective down to about 600 F but cooling from here down requires different heat transfer principles. An attempt is made to speed up the last 350 F of cooling by circulating the atmosphere gas and creating turbulence in the cooling chute. The use of water cooled rolls in the final cooling passes could be very effective. Where some discoloration of the annealed strip is not objectionable, the water dip could also be used to reach final cooling temperatures. Final cooling is accomplished by two vertical passes between air blast chutes after the strip leaves the furnace cooling zone, plus some additional cooling as the strip travels through the exit end bridles, loops and onto the rewind reels at which point the strip will average a little over 200 F.

To sum up, the continuous cleaning and annealing

line operation has its ever-present problems, a few of which have been solved, and these are as follows:

In order that line speeds could be raised from around 550 to over 900 fpm through the furnace, it was necessary to first balance and perfectly align the motor driven furnace rolls. Then the rolls had to be shaped in order to obtain the self-centering effect of the centering rolls. Back tensions as controlled by the tension unit ahead of the furnace were found to be of minor importance for strip guiding. In order that the strip would enter the furnace well centered, a split self-aligning roll was installed ahead of the strip entry into the furnace. The tracking of strip through the cleaner was also improved by shaped rolls.

Since the strip travels over both rubber and steel rolls, the strip surface is subjected to various surface hazards. In the holding and slow cool zone, the alloy rolls are subjected to a build-up condition that is probably due to the air infiltration into the furnace which causes an oxide build-up and requires polishing for removal. There are solution salt build-up conditions in the cleaner section that also cause surface damage as well as off tracking through the cleaner. This results in poor cleaning or strip breaks.

The major roll problem, however, is with the rubber covered rolls. Much improvement has been made by the rubber people in providing a rubber roll that can be called non-glazing and one that can withstand higher temperatures. The non-glazing feature helps to improve roll life because the rolls can be used four and five times longer before the frictional and tracking quality of the roll requires surface grinding. The ability to withstand higher temperatures avoids the chances of getting rubber pick-up on the annealed strip surface. Obviously, strip contaminated with rubber will not tin coat.

With the continuous cleaning, annealing and cooling line in Gary, it is possible to cut off the average six-day delay in processing coils that is required for annealing in the batch type coil annealing department. While there is a place for continuous strip annealing, it is unlikely it will replace all batch type annealing.

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Pittsburgh (22), Pa.

By RUDOLPH TIETIG, JR., Engineer, A. J. Boynton and Co., Chicago, Ill.

Ferro-Manganese Additions in Open Hearth Steelmaking

. . . . controlled addition of manganese at proper point in ladle accomplished by mechanical feeder should give a minimum saving in manganese cost of $0.15 per ingot ton, and for some grades of steel, reductions in cost up to $0.30 a ton . . . . unit was amortized in less than six months . . . .

▲ THE addition of ferro-manganese to an open hearth heat may be made to the furnace just prior to tapping, or to the ladle while the steel is running into it, or partly to the furnace and partly to the ladle. Because the loss of manganese through oxidation is smaller when the addition is made to the ladle, it is desirable to follow that practice whenever possible. However, many operators and metallurgists believe that there is a limit to the amount of manganese that can be so added. For example, the United States Steel Corp. has a limit of about 17 lb of the ferro-alloy per ton of ingots. The late Dr. Herty stated at the 1941 Open Hearth Conference of the AIME that "an excessive ladle addition of manganese is when you begin to get non-uniformity in the ingots." He then cited as an example of maximum practice, the addition to the ladle of 1700 lb of the alloy to a 120-ton heat, which is equivalent to 14.1 lb per ton of ingots.

A special committee of the American Iron and Steel Institute published in 1949 a report entitled "Problems Involved in the Conservation of Manganese." This report states that "there are definite limits to the amounts of manganese which can be added to the ladle from a steel quality standpoint for various grades and the balance of the manganese must be added to the furnace." The report did not state what these limits were.

METHOD OF ADDING ALL MANGANESE TO THE LADLE

A search through the literature on the subject of manganese additions and conservation did not disclose the reasons why no more than, say, 17 lb of ferro-manganese per ton of ingots could be added to the ladle. This was of particular interest during the stages when the designs for the open hearth plant of the Lone Star Steel Co. were being developed. It was known that one of the principal grades of steel to be made at that plant would be 0.23 to 0.26 per cent C., 1.00 to 1.15 per cent Mn. semi-killed steel for A. P. I. casing. This grade would require the addition of about 28 to 30 lb per ton of ingots of 80.0 per cent ferro-manganese if it were all added to the ladle. Hence, consideration was given to means by which that amount could be introduced into the ladle and still give a satisfactory product.

It was assumed that the reason ladle additions of manganese were limited was due to the method of making the addition. In most plants, except where it was thrown in by shovel or in bags, the material was added through a hopper and chute arrangement fitted with a gate. When the ladle was about one-third full, the gate was opened allowing the manganese to fall into the ladle at an uncontrolled rate. If too much material were added at one time, some might float on top of the steel and eventually enter the ladle slag, or localized freezing might occur. It was therefore felt that the rate of adding the manganese should be controlled to correspond to the rate the ladle was being filled.

Also considerable importance was attached to the point in the ladle where the addition was made. It was thought that the manganese should contact the molten steel as near as possible to the descending stream, and

then enter the swirl of metal which results from offsetting the ladle with respect to the furnace runner.

Both the ability to control the rate of adding the material and the provision of a means for adding it at the correct location were incorporated in the design of what may be termed a ladle additions feeder.

This mechanism is shown in Figure 1. It consists of a hopper, an electrical vibrating feeder, and a chute. The assembly is moved forward and backward by two air cylinders. As it moves forward, the chute, which rides on a fixed roller, is lowered toward the ladle and its end approaches the desired location. After the material has been added, the assembly is moved backward, thereby preventing damage to the chute as the metal approaches the top of the ladle. Additions are generally started when the ladle is about 20 per cent full and completed by the time it is 80 per cent full. The rate of feed is adjusted manually by turning a small hand wheel on a control panel. The rate can be varied over a wide range. The feeder shown in Figure 1 can be regulated to add 10,000 lb of manganese in three minutes, or 3,000 lb in twenty minutes or even longer.

TEST DATA

Each of the four furnaces in the plant of the Lone Star Steel Co. is equipped with a unit. Figure 2 shows one of the units in its retracted position. Their performance has been entirely satisfactory as indicated by data in Tables I, III, and IV. Table I consists of data pertaining to amounts of manganese added and manganese recovered. Tables III and IV give data concerning the manganese spread in the individual heats. Eighty-two heats, selected at random, were studied to obtain the information in these tables.

Regarding the data in Table I, the following should be noted:

TABLE I

Data Pertaining to Manganese Added and Recovered

Item No.			
1	Steel analysis ordered —	Carbon — 0.23 to 0.26 per cent Mn — 1.00 to 1.15 per cent P — 0.025 per cent max S — 0.045 per cent max Si — 0.04 to 0.06 per cent	
2	Average weight of heats, including butts and skulls	217.9	tons
3	Manganese in bath prior to tap	0.16	per cent
4	Manganese in ladle test at middle ingot	1.09	per cent
5	80.0 Per cent ferro-manganese added to ladle	6073	lb
6	Ferro-Mn added to ladle per ton ingots	27.9	lb
7	Manganese added to ladle	4871	lb
8	Manganese in bath prior to tap	697	lb
9	Manganese in bath plus manganese added to ladle	5568	lb
10	Manganese in ingots, butts and skulls	4750	lb
11	Manganese lost on tapping	818	lb
12	Manganese recovered	85.3	per cent
13	FeO in final slag	14.35	per cent
14	C in bath at tap	0.16	per cent

Item No.1—The steel analysis ordered with respect to the carbon and manganese ranges is much more rigid than that required by the standards of the American Iron and Steel Institute. For the grade of steel ordered, the standard range for carbon is 0.07 per cent and for manganese 0.30 per cent. These ranges should be compared with 0.04 per cent for carbon and 0.16 per cent for manganese, that were ordered. No difficulty was encountered in staying within these limited ranges. Only three heats out of the 82, or 3.7 per cent, could be classified as missed because of manganese content. This is a much superior practice to that reported in a study by the American Iron and Steel Institute designated as "Contribution to the Metallurgy of Steel—No. 35, Survey of Open Hearth Alloy Steel Off-Heats and Residual Elements." Data taken from that study, which was published in 1949, are given in Table II.

TABLE II

Data Pertaining to Heats Not Meeting Manganese Specification

Manganese level, per cent	Specified range of manganese Content, per cent	Total number of heats	Number of heats outside manganese specification	Per cent of total heats missed
0.60 to 0.90	0.20	5370	490	9.1
0.70 to 1.00	0.25	4252	179	4.2
0.70 to 1.00	0.30	1317	14	1.1

The data in the Institute study indicate that the higher the manganese level, the greater the number of heats that will be missed for a given manganese specification range. Since the manganese level of the 82 heats was 1.00 to 1.15 per cent and since the range was only 0.16 per cent, it could be expected that 10 to 20 per cent of the total heats might have been missed because of manganese content. It is believed that the method of adding the manganese was the principal factor in holding the missed heats down to the previously stated total of 3.7 per cent.

Item No. 2—The heat weight of 217.9 tons includes both usable and scrap butts and ladle skulls. Other pit scrap is not included. Since there was only one running stopper in the 82 heats, the amount of other pit scrap was small.

Item No. 3—All but 20 of the heats studied had 2,000 lb of spiegel added to the bath about 15 minutes before tapping. Since no preliminary tests were taken after adding the spiegel, the manganese content of the bath for those heats where spiegel was used was calculated by adding a percentage equal to 50 per cent of manganese in the spiegel to the last preliminary test. Where spiegel was not added, the last preliminary test was used.

Item No. 4—It was assumed that the ladle test taken at the middle ingot represented the average manganese content of the heat. An average of the tests at the first, middle and last ingots would not be as nearly correct because a ladle test taken at the last ingot is frequently much lower than if it were taken at the second last ingot. This is due to the action of the ladle slag on the metal.

Item No. 5—The ferro-manganese used was a nominal 80.0 per cent grade. Actually, most of it added to the 82 heats analyzed 80.2 per cent. This was taken into consideration in calculating the amount of pure manganese added.

Item No. 6—To this weight of 27.9 lb of ferro-manganese per ton of ingots may be added 1.4 lb of 50 per cent ferro-silicon which was also added to the ladle. The total average ladle additions were therefore 29.3 lb per ton ingots. The maximum amount of ferro-manganese added to any of the 82 heats was 31.5 lb per ton of ingots, butts, and skulls.

Item No. 7—The weight of pure manganese added to the ladle was, as previously mentioned, calculated by multiplying the weight of the ferro-alloy by its actual manganese content.

Item No. 8—The weight of manganese in the bath was calculated by multiplying the weight of the ingots, butts and skulls of the individual heats by the last preliminary manganese analysis plus the necessary adjustment for spiegel, when it was used.

Item No. 9—This amount of 5,568 lb is the sum of Items No. 7 and 8.

Item No. 10—The manganese in the ingots, butts and skulls was calculated by multiplying their weights in the individual heats by the ladle test at the middle ingot for the same heat.

Item No. 11—The manganese lost on tapping was assumed to be the difference between Items No. 9 and 10.

Item No. 12—The per cent of manganese recovered was calculated by dividing Item No. 9 into Item No. 10 and expressing the result as a per cent. This method of calculation does not distinguish between how much of the manganese lost was residual manganese and how much was manganese added to the ladle. In some plants it is assumed that there is no loss of residual manganese on tapping, and that all manganese lost is part of the manganese added to the ladle. This has led to the term "Manganese efficiency" which, using the data in Table I, would be manganese added to the ladle (Item No. 7) less manganese lost on tapping (Item No. 11) divided by the manganese added to the ladle (Item No. 7). This equals 83.2 per cent. However, it is most unlikely that there is no residual manganese lost in tapping. In fact, it is more probable that the percentage of residual manganese lost on tapping is greater than the percentage lost of manganese added to the ladle. The remarks by Mr. L. F. Reinartz at the 1941 National Open Hearth Conference of the AIME in commenting on certain German practices intended to conserve manganese bear out this opinion.

Item No. 13—This is the average of the FeO in the slags of the 82 heats. The slag samples were taken immediately before adding the spiegel.

Item No. 14—This is the average of the carbon content of the samples of the 82 heats taken immediately before adding the spiegel. The manganese in these samples was the basis for determining the residual manganese.

As previously stated, Tables III and IV present data based on the 82 heats studied that relate to the manganese spread within the individual heats. Table III lists the number of heats having a particular spread from the ladle test at the first ingot to the ladle tests at the middle ingot and from the ladle test at the first ingot and the ladle test at the last ingot.

TABLE III

Data Pertaining to Manganese Spread

Spread per cent Mn	Ladle tests at first and middle ingot No. of heats	Ladle tests at first and last ingot No. of heats
None	28	12
0.01	8	9
0.02	22	16
0.03	13	9
0.04	6	11
0.05	3	10
0.06	1	7
0.07	1	5
0.08	..	3
	82	82

Average 82 heats:
Ladle tests at first and middle ingot — 0.017 per cent Mn spread
Ladle tests at first and last ingot — 0.032 per cent Mn spread

Table III should be compared with data submitted by R. D. Hindson of the Steel Co. of Canada in a paper entitled "Factors Affecting Spread in Manganese Between First and Last Ingots," which was presented at the 1951 Open Hearth Conference of the AIME. In this paper the reported manganese spread for fully killed 0.90 to 1.50 per cent manganese heats is as follows:

First ingot to middle ingot ..... 0.008 per cent Mn
First ingot to third to last ingot ..... 0.030 per cent Mn
First ingot to second to last ingot ..... 0.049 per cent Mn
First ingot to last ingot ..... 0.070 per cent Mn

Table IV lists as a percentage of the 82 heats the number of heats having a manganese spread equal to or less than a particular per cent from the ladle tests at the first and middle ingots and the ladle tests at the first and last ingots.

TABLE IV

Manganese Spread — Cumulative Bases

Spread, per cent Mn	Ladle tests at first and middle ingot, per cent of total heats	Ladle tests at first and last ingot, per cent of total heats
None	34.1	14.6
0.01 or less	43.9	25.6
0.02 or less	70.7	45.1
0.03 or less	86.6	56.1
0.04 or less	93.9	69.5
0.05 or less	97.7	81.7
0.06 or less	98.8	90.2
0.07 or less	100.0	96.3
0.08 or less	100.0	100.0

It is apparent from these tables that no difficulties have been encountered with excessive manganese spread due to making all the additions to the ladle. In only three instances is the spread from first to last ingot equal to one-half the manganese specification range of 0.16 per cent, and as previously stated, that specification is much narrower than is customary.

ECONOMICS OF MANGANESE ADDITIONS

The test data having shown that up to at least 31.5 lb of ferro-manganese per ton of ingots can be successfully added to the ladle, consideration should be given to savings in manganese to be obtained from making such additions. These savings occur in two principal ways.

1. The recovery of manganese added to the ladle is about 10 per cent greater than if it were added to the furnace.
2. A narrower manganese specification is possible; hence, manganese additions can be calculated about 0.05 points lower than if some or all were added to the furnace.

The basis for this figure of 0.05 percentage points is the data found in Table II. These data indicate that in order to equal the results when using the feeder with respect to heats missed, the manganese specification range must be a minimum of 0.26 per cent. It may have to be greater because the manganese level of the heats in Table II were less than those studied for this statement. A common method of calculating manganese additions is to aim at the middle of the range. By reducing the range from 0.26 to 0.16 percentage points, which the test data show are possible, means that instead of calculating the manganese to be added 0.13 points above the minimum, it can be calculated to only 0.08 points above the minimum, or a difference of 0.05 percentage points.

A third saving, not as yet proven, may result from the possibility that by controlling the rate of ladle additions, the manganese in heats now having it all added to the ladle could be calculated a few points lower.

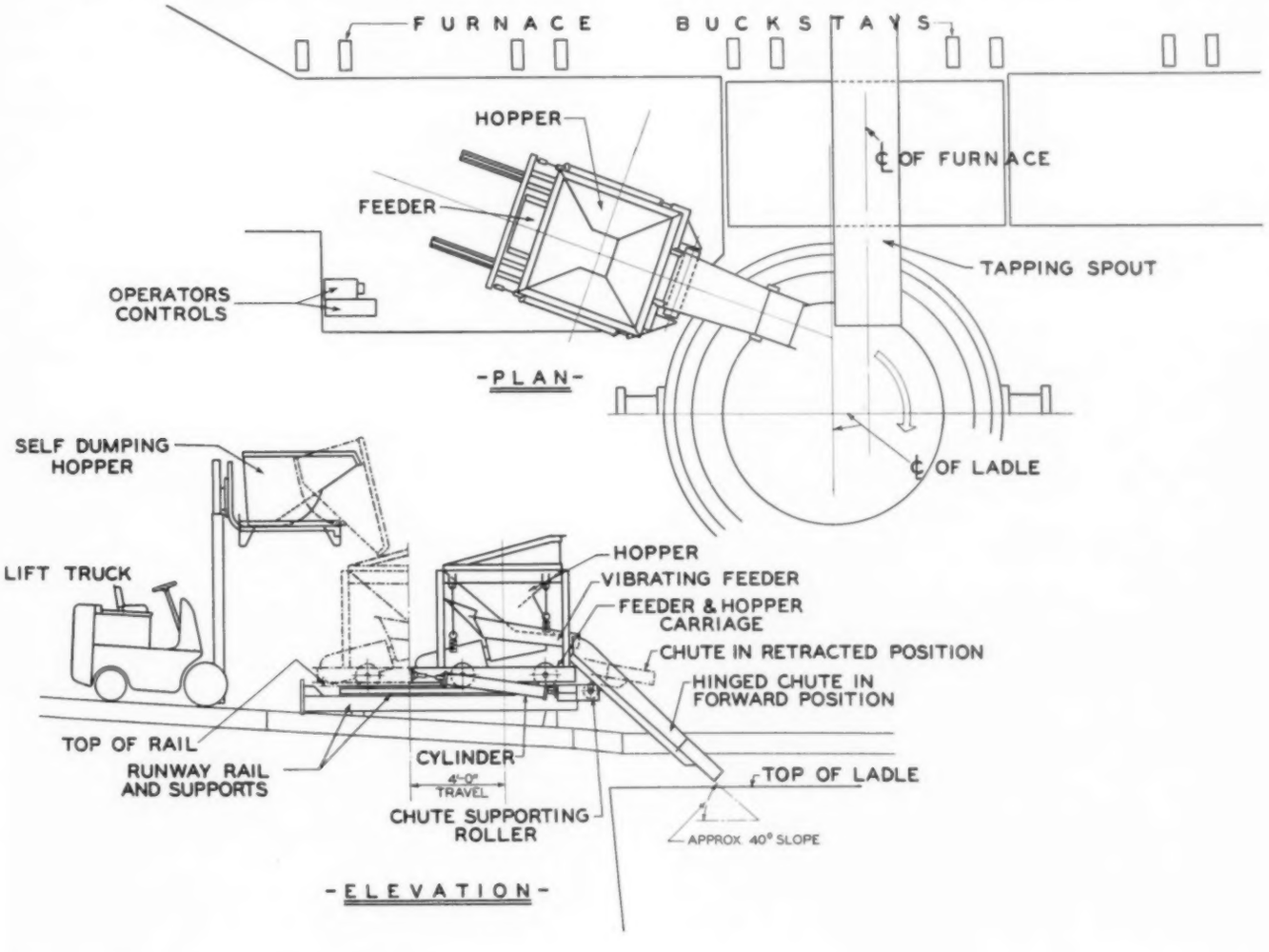
Assuming a price of $0.104 per pound of 80 per cent ferro-manganese, Table V shows the economies resulting from the 85.3 per cent recovery given in Table I compared with 10.0 per cent less, or 75.3 per cent for furnace additions.

TABLE V

Comparison of Manganese Requirements
Ladle vs Furnace Additions

80 Per cent FeMn added to the ladle, lb per ton ingots	80 Per cent FeMn required for furnace additions, lb per ton ingots	Difference 80 per cent FeMn, lb per ton ingots	Reduction in cost of ingots by ladle addition per ton ingots
5	5.67	0.67	$0.069
10	11.35	1.35	0.140
15	17.00	2.00	0.208
20	22.70	2.70	0.281
25	28.32	3.32	0.345
30	34.00	4.00	0.416

Figure 1 — Open hearth ladle addition feeder at Lone Star Steel is loaded by a self-dumping hopper from a lift truck.



By calculating the manganese 0.05 points lower than when making some or all furnace additions, 1.46 lb of the 80 per cent ferro-alloy per ton of ingots will be saved. This equals a reduction in cost of ingots of $0.15 per ton.

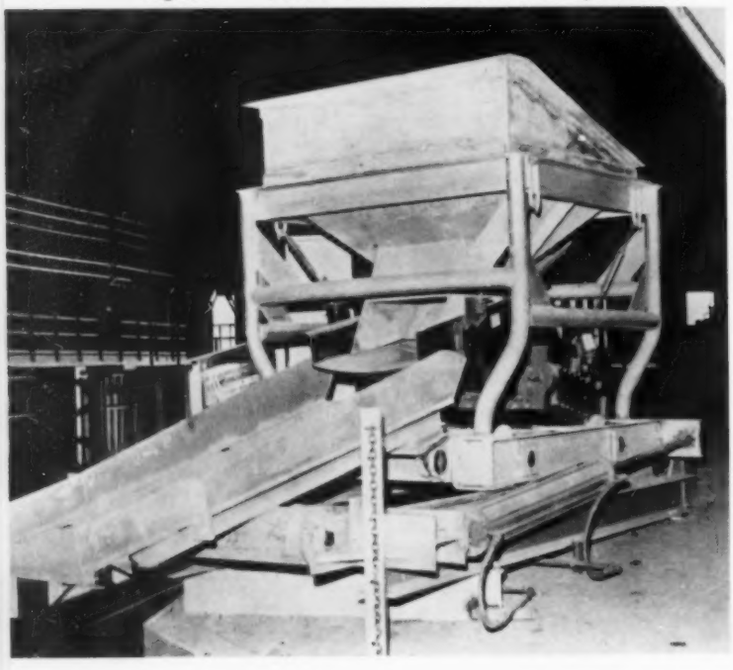
Taking the practice of Lone Star Steel Co. as an example, a limit of 17 lb per ton of ingots for ladle additions would have increased the consumption of ferromanganese, in the 1.00 to 1.15 per cent manganese heats, by 1.4 lb per ton of ingots above that actually consumed. The cost of the additional material plus the savings from calculating manganese additions 0.05 points lower equals almost $0.30 per ton. The production of the 1.00 to 1.15 per cent manganese grade only by each of the furnaces at Lone Star averages 9,000 tons per month. With a $0.30 per ton savings, the cost of the feeders were amortized in considerably less than six months.

ADAPTABILITY OF FEEDER

The feeder shown in Figure 1 was designed especially for the open hearth plant of the Lone Star Steel Co. It is not likely that this same feeder could be used without alteration in any other plant. The hopper is too high to be filled manually. At Lone Star, a self-dumping box carried by a fork lift truck is loaded with a measured weight of manganese while standing on the open hearth floor scale. However, there are numerous variations in design that can be made. These include replacing the fixed hopper with a drop bottom bucket that can be filled at another location and then placed on the feeder framework by a crane.

A built-in scale can be incorporated in a design. Such a scale would utilize load cells of the strain gage type. Since part of the live load is carried by the vibrating feeder and part by the hopper, it would be necessary for the load cells to carry both the hopper and the feeder. This can be accomplished by placing the load cells between the hopper and the framework supporting hopper. Vibrations from the feeder that might disturb the load cells are dampened by springs between the feeder and hopper.

Figure 2 — Feeder is shown in retracted position.



By incorporating a scale in a unit, two methods of weighing can be followed. Either the hopper can be loaded with the exact amount of material to be added to the heat, or the hopper can be completely filled and a dial set to stop the feeder when the required amount has been added to the heat. This type of built-in scale can be readily incorporated in the Lone Star feeders.

As long as the basic features of controlling the rate of the addition and making the addition at the correct location are incorporated in the design, results equal to those experienced by the Lone Star Steel Co. should be expected. Those results indicate that a minimum reduction in manganese consumption equal to $0.15 per ton of ingots should be attained, and that for some grades of steel ingot costs can be lowered by $0.30 or more per ton. Furthermore, the number of off heats can be materially reduced.

The author of this paper submits these findings to the steel industry as a whole, with the hope they will contribute in a small way to improved practice and a conservation of raw materials.

DISCUSSION

PRESENTED BY

J. M. BRASHEAR, General Superintendent, Lone Star Steel Co., Lone Star, Texas

EARLE C. SMITH, Chief Metallurgist, Republic Steel Corp., Cleveland, Ohio

PAUL W. NUTTING, Assistant Superintendent No. 2 Open Hearth, Inland Steel Co., East Chicago, Ind.

C. C. BENTON, Superintendent, Open Hearth and Bessemer, Algoma Steel Corp., Ltd., Sault Ste. Marie, Ontario, Canada

RUDOLPH TIETIG, JR., Engineer, A. J. Boynton and Co., Chicago, Ill.

RALPH D. HINDSON, Works Metallurgist, The Steel Co. of Canada, Ltd., Hamilton, Ontario, Canada

J. M. Brashear: Mr. Tietig should be complimented on a very nice development of the subject of manganese conservation. I am quite sure all of the open hearth men are very much concerned with that. I brought a few figures with me and I can assure you that after some fifteen months of operation with the vibrating type manganese chute it can be regarded as successful.

The data that I will offer covers the period of time since the operation got under way, which was just before the middle of June 1953.

From that period of time up until September 1, we had tapped 1945 heats, with a tonnage of about 412,330 tons. The tonnage used to September 1, 1954, was 411,372 tons. The tonnage actually scrapped was 69 tons. Tonnage in ingots, as yet not rolled, is 891 tons. Total tonnage not applied is 1362 tons. The percentage of tonnage not applied was 0.33 per cent.

We have had no serious failures in unit operation.

At the time I first saw this unit on the board, before it was delivered to us and mounted, I had the usual misgivings as to the mechanics of the unit. However, most of those fears have been dispelled. We have made some minor changes to the mechanism which are not covered in Mr. Tietig's paper, although I am quite sure he is aware of them.

We found it necessary to cover that portion of the chute from the vibrator down into the ladle. It was discovered rather early that when there was a relatively fast tap, some of the slag and steel splashed out into one portion of the chute. When this occurred, we were faced with the problem of some of the stock hanging. Likewise, the engineering work on the chute length had to be adjusted in the field. That, of course, was calculated originally and was about 14 in. too long. We also had a little trouble with the wiring. In the original installation it was wired with some other equipment. On three occasions we found that the other equipment had been used, the circuit breaker had kicked out, and we did not find it as soon as we should have.

We also had to make another minor change in design and increase the throat area to avoid jamming of some of the manganese. We crush manganese as we use it. We do not carry an extended inventory of crushed manganese. We attempt to crush to a 4 x 4 in. size and eliminate as many fines as possible.

In respect to practice, during the past fifteen months we have used hot metal ranging from a high of 70 per cent to an all cold charge.

Currently we are operating on a 35 per cent metal and 65 per cent scrap charge. We do not enjoy the consistency of iron analysis that is available to many operators. We operate our furnace on merchant iron most of the time. We do not swing the furnace to make basic iron and foundry iron. We live largely on a diet of hot metal of 1.75 to 2.25 per cent silicon, and frequently find it necessary to use some 3 per cent silicon iron.

Generally, we are quite well off as far as sulphur is concerned, but we do find ourselves at times using iron that contains 80 to 90 points sulphur and up to 0.520 per cent phosphorous.

As Mr. Tietig indicated, we have modified the practice somewhat to the data that was originally submitted to him, because we have been making, as we refer to it, "oil country goods," alluding to casing. We found it necessary to increase our manganese to meet the J-55 API specification, and are now working in the 1.20 to 1.30 per cent manganese range.

During the past three months, we have tapped 401 heats, producing 87,784 tons. Of those heats, 277 have been over one per cent in manganese and 124 heats have been under one per cent. In this group of 401 heats, we have had three heats that wound up with floaters. The off manganese in tonnage represents 78 tons. During this period, heats tapped were of an analysis of 0.24 to 0.27 per cent carbon, 1 to 1.15 per cent manganese or 1.15 to 1.25 per cent.

Regarding the efficiency, I am going to reduce Mr. Tietig's figure to layman's language. In the manganese range of 1 to 1.25 per cent, in 277 heats the manganese efficiency was 67 per cent. Of the manganese that was added, there were 124 heats made in the 0.40 to 0.70 per cent manganese range, with an efficiency of 69.31 per cent, with all manganese added to the ladle.

We generally use spiegel ten to fifteen minutes before tap, with an average addition of approximately 2000 lb. We continue to assume that we get about a 50 per cent manganese recovery from the spiegel.

We likewise add some 50 per cent ferro-silicon, usually in the magnitude of about 200 or 300 lb. This is also added to the ladle with the manganese.

In explanation, in part, on the occasions where there were floaters, most of them were caused by a condition that could not be readily controlled. The shop is laid out in a north-south direction, with the prevailing winds from the south. The feeders are located on the north side of the runner. We have an appreciable amount of wind, as you may know. Quite frequently when we are tapping a heat the wind will kick right up through the pit, and it becomes very difficult for the melter to see the manganese as it is being added to the ladle. When this occurs, it is possible for the melter to add the manganese either too soon or not soon enough.

Earle C. Smith: This interesting paper deals with the conservation of manganese, an alloy of much concern to our industry, especially during the critical situations of war time. Manganese is essentially an import, about which we, as a nation, have not been too sensible in providing stockpiles to take care of emergency war needs.

The amounts of manganese that must be added to different kinds of steel vary for several reasons. Habit and reluctance to inquire into the real need for manganese remains a real obstacle to lowered use. A fixed attitude of mind can be much more an obstacle than engineering problems of material handling.

This paper presents a record of the use of an ingenious mechanical device which, because of its ability to feed alloy to a ladle of steel, permits a substantial saving of the amount of alloy to meet the existing set of demands, and without sacrificing quality.

In the minds of many there may be a question about the product. In answer let me point out that the material involved is oil industry pipe, a product subject to individual piece inspection to standards set by the API, not by the producer of pipe. The usual plant inspection is only preliminary to inspection by engineering companies' skilled specialists in such materials. Any material that passes such standards needs no searching metallurgical check for quality.

The labor saving by lift truck charging and machine feeding can best be appreciated by those who at some time have shoveled manganese from the back platforms of the older shops. Any one who worked behind the thin backwalls of open hearth furnaces a generation ago will understand that this mechanized method saves much more than the value of the manganese involved.

If our industry is to increase its productivity by the 3 per cent per year required to remain alive and capable, we must encourage the use of more machines. Europeans say of us that no job in the United States is so humble that it will not be done by machine power.

It has been my experience that once we provide a capable machine to reduce the heavy labor, our returns in control of quality and production will increase much faster than the estimates of saving indicate. I hope we have more such machines.

Paul W. Nutting: I want to compliment Mr. Tietig on a very informative paper which I believe sets down for the first time the effectiveness on manganese recovery of evenly distributed ladle additions. I have seen the chute described by Mr. Tietig in operation at Lone Star and can attest to its mechanical effectiveness as well. For the newer shops with an abundance of platform room, it undoubtedly offers a more than satisfactory method of making ladle additions. However, for the older shops where working room is forever at a premium, a chute of this type is difficult if not impossible to install. This does not, however, remove the necessity for the operators of these older shops to compete on cost basis with their more modern brothers. We, at Inland, long ago recognized the desirability of adding as much as possible of the manganese necessary to meet the ordered analysis to the ladle. As Mr. Tietig pointed out, this practice results in a higher rate of manganese recovery and a better distribution of manganese throughout the heat. Since we were limited as to floor space behind our furnaces, our only alternative was to increase the depth of the hopper on our existing chutes and improve the dumping mechanism to eliminate sticking at the last minute as so often happened on our old style chute. These changes made it possible for us to increase the weight of ferro-manganese added to the ladle from approximately eighteen to more than twenty-nine lb per ton if desired. It is my belief that it was a mechanical limitation such as I have just mentioned that led to the figures quoted by Mr. Tietig at the beginning of his report. At least in our experience, we have not reached a limit, other than mechanical, on the weight of ladle additions which can be made.

Since we too produce casing stock in the analysis ranges quoted by Mr. Tietig, I have prepared some comparative figures between Inland and Lone Star practices. Steel of this grade is ordered in our shop with percentages as follows:

C	Mn	P	S	Si
0.24 to .27	1.00 to 1.10	0.035 max	0.040 max.	0.10 max

Note that in respect to manganese our range is somewhat more restricted than that shown in Mr. Tietig's paper. Our furnace practice for this type of steel is also somewhat different in that we add approximately half of the total required manganese to the bath as silicomanganese, the remainder being added to the ladle in the form of ferro-manganese. Calculating the manganese recovery on the same basis as was done by Mr. Tietig our recovery is 79.6 or 6.8 per cent lower than that given in the paper. This differential is to be expected since a large portion of our manganese was added to the bath. This, of course, only serves to strengthen Mr. Tietig's contention that ladle additions are more economical than bath additions because of the higher recovery. It must be pointed out, however, that of the 63 heats selected at random for this study, none were "missed" because of manganese outside the ordered range on ladle tests taken on the first and next to last ingots. There were some last ingots degraded because of manganese fading.

Based on experience gained on other high manganese grades, we are developing a practice for the high manganese casing stock which will enable us to add all of the manganese to the ladle as ferro-manganese. We hope that this will enable us to match the recovery quoted by Mr. Tietig. If we do not quite make it, it will undoubtedly be because of our inability to evenly distribute the ladle additions because of the mechanical limitations of our chutes.

C. C. Benton: Mr. Tietig has given a clear description for what appears to be an effective mechanism for adding material to the ladle at a controlled rate. If the hopper and shaker could be adapted to considerably less areas than that available at Lone Star, operators should give consideration to this type of equipment. However, as operators we are familiar with the fact that mechanical and electrical equipment occasionally breaks down at a critical time. Can Mr. Tietig give us the outage time that has been experienced on the feeders? From an equipment and methods view-point this equipment is definitely interesting, but for a clearer understanding of the economics to be obtained several factors need clarification.

The majority of the heats used for the calculation of manganese efficiency had an addition of 2000 lb of spiegel to the furnace. The arbitrary use of a constant recovery of 50 per cent of the manganese content in the spiegel to calculate the efficiency is different from our methods at Algoma, in that, we use the total manganese added in the bath, in the ladle, and the residual manganese contained in the bath to calculate yields. On examination, with the total manganese used, the yields reported would have been less. We would like to ask Mr. Tietig what the difference was in manganese yields between heats using spiegel and those not using spiegel?

In speaking of the economics of this method of manganese additions in which he says that a narrower manganese specification is possible, our experience on a split manganese practice at Algoma shows an even lower manganese spread than that quoted, and as a consequence, if we were studying the economics of this method, we could not assume this saving. For example, we have an average spread of manganese of 0.029 per cent and for missed analyses we have a total of 3.7 per cent with only a 5 per cent difference in manganese yield. This is based on 82 consecutive heats of 0.70 to 0.90 per cent manganese.

Can Mr. Tietig give us information on the feeder method of manganese addition on open steels rimmed or capped? If so, what was his spread in manganese and what economics? If not, is it his opinion that we would realize a decreased spread of manganese and the same degree of savings? Metallurgical thinking and data are still important phases of ingot production.

Does Mr. Tietig have any factual data, ie: conditioning cost and per cent rejections at the plate mill which would give use some indication of comparative steel quality obtained by the following methods of manganese additions to the steel?

a. Total manganese to the ladle.
b. Total manganese to the furnace.
c. Manganese divided between ladle and furnace.

In calculating savings on manganese did Mr. Tietig take into consideration the 5 per cent premium price paid for crushed manganese 2 in. x D over lump?

Rudolph Tietig, Jr.: The principal questions were asked by Mr. Benton and can be answered as follows:

1. Twenty of the 82 heats studied did not have spiegel added to the bath. On those heats the recovery of manganese, on tapping, calculated by dividing the manganese in the ingots, butts, and skulls, by the residual manganese plus the manganese added to the ladle, was 86.1 per cent. The average recovery, on the same basis, for the 62 heats where spiegel was used, assuming 50 per cent of the manganese in the spiegel to be lost before tapping, was 85.3 per cent.

   Manganese efficiency calculated by dividing the manganese added to the ladle less manganese lost on tapping by the manganese added to the ladle was 84.7 per cent for the heats where spiegel was not used. Where spiegel was used and assuming 50 per cent of its manganese content lost before tapping, the efficiency was 83.0 per cent. If no loss of manganese in the spiegel is assumed the manganese efficiency drops to 78.9 per cent.
2. There is no factual information available regarding the results from using the feeder when making open steel, rimmed or capped. It is our opinion, however, that the feeder will tend to lessen the spread of manganese in open steels to the same degree as it does in semi-killed or killed steels, provided they are all of the same manganese specification. However, the manganese content of semi-killed and killed steels can be and frequently is much greater than is possible in an open steel. It, therefore follows that the feeder would provide greater savings to many producers of semi-killed and killed steels than to producers of open steels.
3. We do not have any factual data as to the effect of using the feeder on steel conditioning costs and rejections. All manganese additions at Lone Star, from the very start of operations, with a few exceptions, have been made by the feeder. However, experienced observers report that the slabs produced are equal to or better than those of any other producer. Much less than 10.0 per cent of all slabs require any conditioning.

   We do not attribute this excellent practice to the use of the feeder, but rather to the grades of steels being produced, the excellence of the heating practice in adequately controlled soaking pits, and the low sulphur content of the open hearth fuel; largely natural gas.
4. No allowance was made for the 5.0 per cent premium price paid for crushed manganese over the lump material.
5. It may be of interest to know that we have recently modified the design of the Lone Star feeder so that it is being considered for use in one of the oldest open hearth shops of the Chicago area. Conditions in that shop are such that a loading device had to be incorporated in the design as the manganese could only be delivered to the mechanism in wheelbarrows.

Ralph Hindson: I would like to ask Mr. Tietig if in my paper was not I comparing and working with low carbon rimming steels, and were not the figures he quoted showing the manganese variance or spread throughout the heat on that grade of steel. On the grade of steel he is talking about, with the higher manganese and the silicon addition, it would and should reduce that spread, because with the higher manganese and the higher silicon you would have less free FeO coming from your reaction with your slag and your ladle brick. Therefore, your spread should be considerably less, and in our experience is less.

Rudolph Tietig, Jr.: No in your paper the reported manganese spread was for fully killed 0.90 to 1.50 per cent manganese heats.

Ralph Hindson: I stand corrected. There is one other point that I would like to make. Our practice has been for some years to add up to 100 points of manganese to the ladle. We agree with Mr. Tietig on the economy of doing this. On higher quality grades, however, it is now our practice, in view of present conditions, to reduce the amount of manganese to 70 points to the ladle. I am not implying that the grade referred to by the speaker is not a quality steel, but with the way these particular ingots solidify and their end use you should not have any particular trouble by adding 100 points of manganese to the ladle, in view of the fact that you do not get a very acute segregation on that type of steel. When you compare this with, say, core wire, rope wire, etc., you have a different story and you have to be careful about how much manganese you add to the ladle.

I think the comments on adding the manganese throughout the heat, and more particularly the condition of the tap, are a very important factor on your manganese recovery and your success in being able to add manganese to the ladle in that quantity.

Why do you add spiegel?

J. M. Brashear: I had hoped to avoid getting into a lot of controversy over practice, but certainly I will have to say that no one should use spiegel if he can avoid it. We have tried both ways. Because of the very limited carbon ranges in which we work, with the full knowledge that to coke back a heat is not desirable practice, and working at what we hope and believe is reasonable efficiency, we find that it is to our advantage economically to use spiegel.

I don't know that I could give any better answer than that. I might pick up one or two other points in Mr. Benton's discussion here and an implication, in part, that "oil country goods" are not tough steels to make. I can assure you they are very tough to make. As Mr. Smith mentioned, we do not set the pace ourselves. It is set for us.

C. C. Benton: Conditioning costs play a very large part in quite a few operations. What are your conditioning costs? Just give us some indication.

J. M. Brashear: We do not maintain a full-time chipping or scarfing crew.

MAINTENANCE OF MOBILE EQUIPMENT

. . . . materials handling department described is unique in that it has a complete maintenance organization to handle its mobile equipment . . . . truck operators also are responsible for inspection and minor repairs, resulting in their taking a personal interest in the equipment . . . .

PART I

By FRANK C. WIER
Superintendent of Material Handling
Steel and Tube Div.
The Timken Roller Bearing Co.
Canton, Ohio

▲ IN the steel industry, mobile equipment is coming into more and more usage. The equipment generally classed as "mobile" consists of highway trucks, straddle trucks, fork lift trucks, front end loaders and many other small pieces of rubber-tired equipment. Crawler track type equipment such as bulldozers, etc, can also be included in this category. For instance, in our own plant, our mobile equipment consists largely of automotive type vehicles powered either by electric motors or internal combustion engines.

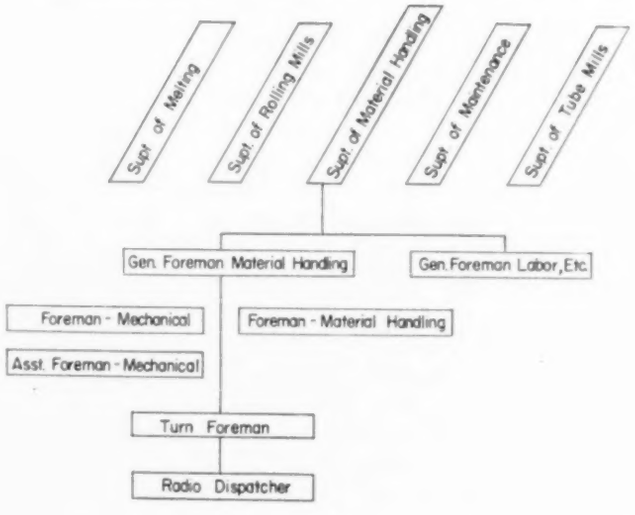
Maintenance of this type of equipment is becoming a major problem, because such maintenance does not fall into the usual pattern of a general steel mill set up. Only in comparatively recent years has the importance of proper materials handling been recognized, and only recently has mobile equipment been used to any extent in steel mill practice. Therefore the impact of the related maintenance problems has been rather sudden, and many of the problems are relatively new. As a result, the operating policies of the industry have required alterations in varying degrees, and the departments responsible for maintenance have had to cast about for suitable solutions to the problems arising from the use of this new type of equipment.

What has been done by the steel and tube division of the Timken Roller Bearing Co. to solve some of these maintenance problems is the basis of the following discussion.

ORGANIZATIONAL SET-UP

The Timken Roller Bearing Co. has deemed it imperative to establish certain operational policies which will best facilitate our materials handling and production schedules. One of these is the loading or unloading of all railroad cars within the forty-eight hour demurrage — free period. Another is the storing of in-process materials outside of the operating buildings so that the overhead cranes which supply material for the various operations need never rehandle these materials for storage purposes. Such policies indicate a desire for an effective and flexible operational situation, and the maintenance of the mobile equipment which serves these operations must be equally effective and flexible if shutdowns and production delays are to be avoided. The type of maintenance organization neces-

Figure 1 — The operating and maintenance organization shown in this chart illustrates how both functions head up into a common general foreman while the superintendent is found on a level with the other operating superintendents.



sary to effectively execute these policies departs somewhat from the traditional maintenance set up, as we shall try to point out. The type of organization to which we refer, emerges in the following manner.

Figure 1 shows an organizational set up which provides a great deal of flexibility as related to what is to be repaired, when it is to be repaired and the manner of repair. There is no bickering between departments as to whether a particular piece of equipment should be shut down for an extensive repair or whether it should continue in service because the workload is particularly heavy. The decision becomes automatic when the workload is extremely high, in that certain items of maintenance must be postponed until the operational pressure is somewhat relieved. However, the "catching up" interest and effort in such maintenance must be commensurate with that which was expended in keeping the operational functions at their high level.

The millwright of twenty-five years ago with his hammer, wrench and crowbar is rapidly disappearing from the maintenance forces of most steel mills. Even so, his more modern counterpart is not usually adept in the maintenance of present day automotive type equipment. It is true that general steel mill maintenance has improved. But, even with this improvement, it does not provide an adequate system for the maintenance of mobile equipment when such a system must fall within the framework of general maintenance. When automotive equipment is thrown in with regular mill procedures and supervision, it soon becomes unserviceable, and then presents a very high maintenance cost. Inasmuch as such equipment cannot and will not stand the rough and tumble usage of yesterday's mill practices, and inasmuch as the function of such equipment is so vitally linked to production schedules, we feel it is necessary to organize a separate maintenance unit for mobile equipment so that its operation and maintenance can be controlled in all its phases.

MAINTENANCE POLICY

It is our policy to maintain all of our equipment in such a manner that periodic and complete overhauls are unnecessary. We cannot agree that running equipment as long as it will operate and then shutting it down for major rebuilding is sound maintenance policy. We believe it is better to keep the equipment in good shape for its entire life rather than to limp along with equipment in a bad state of repair only to be finally overhauled at considerable expense. Neither do we subscribe to the theory that maintenance must be done on a "give and take" basis. On the contrary we believe that maintenance is in a position to "give" but never to "take" where production and its related operations are concerned. Actually there are a number of factors which dictate the very organizational structure of such a maintenance program.

The most important of these is maintaining top quality of manufactured product and being punctual with delivery schedules of that product. We must remember that the customer dictates the quality and delivery date and he's not interested in the maintenance foreman's headache because No. 77 is due for its periodic overhaul. We know that if our company is to produce

Figure 2 — Steel billets and tubes are collected in this yard to be loaded on highway trucks by means of heavy fork lift trucks.

the best product and deliver it on the best possible schedule, we must practice the best possible maintenance method. And in any competitive field, such a program cannot tolerate extensive delays or curtailed production which is brought about by ceremonial downtime for maintenance of equipment.

Then there is the factor of the impact of our maintenance methods on other plant departments. The efficiency of each department of an industrial plant has a bearing on the end product of that plant, regardless of whether it is a production or service department. It is obvious then that when we accept the responsibility of providing material handling facilities for these departments, we must take into consideration their limitations and accommodate each situation with an adequate equipment maintenance program. By the same token it is sometimes true that our maintenance program might be dependent upon these departments for assist-

Figure 3 — Heavy duty pneumatic tired fork lift trucks are used to charge billets for furnace heating before piercing into seamless tubes.

Figure 4 — The relationship of the repair shop to gasoline and diesel fuel pumps along with part of the outside storage for larger spare parts is shown above. The mechanic's pick-up truck is shown on the left.

Figure 5 — Orderly line up of straddle carriers at change of turns aids in obtaining proper maintenance. Lights are provided for night inspections by operators.

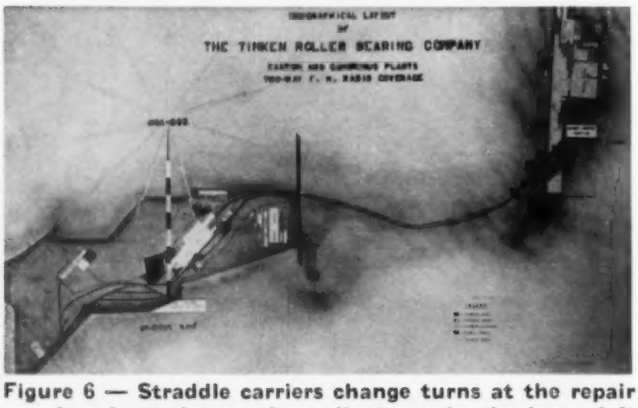


Figure 6 — Straddle carriers change turns at the repair shop located near the radio tower in the lower left portion of the map.

Figure 7 — Communications relative to field breakdown and repairs are handled by the dispatcher of the two-way radio system. Fueling and servicing are likewise controlled also by the dispatcher.

ance such as welding, machining, etc. This again reflects the necessity of a flexible maintenance set up, especially when you are rendering a service that is affected by time, plant geography, customer requirements, availability of supplies and numerous intangible and unforeseen obstacles.

As materials handling people it might be well if you asked yourselves these questions. "Is our present program building morale among our department personnel?" "Are we giving our operators proper equipment with which to do their work?" "Are our mechanics able to keep the equipment in shape?" "Are we recognizing the human strengths and frailties of our personnel?" A successful and flexible maintenance program cannot long succeed unless these questions can be answered in the affirmative. A quick way to develop negative attitudes among maintenance men is to constantly harass them with such words and actions as "overhauling date," "deadline," "production delay," "downtime complaints," and many other "pressure" reminders.

After satisfying the demands of the production departments, and after we have coordinated our efforts with other service departments and have established high worker morale in our own department, our remaining efforts are aimed at paring down and eliminating unnecessary costs. Costs are kept low by careful preventive maintenance, application of quality accessories and spare parts, pride of workmanship and alert supervision.

EQUIPMENT OPERATORS RELATIONSHIP TO MAINTENANCE

The individual operators of this type of equipment should play a definite part in its maintenance. Job descriptions should be written up in a manner that permits operators to assist mechanical people in repairs and enable them to service the vehicles with fuel, oil and water. It is also desirable to have operators wash and clean the vehicles and to do the lubricating within certain limits.

Operators in our plant are not assigned to the same piece of equipment each day. When working on a three-turn basis it is impossible to have just one operator for one vehicle. Since that is true, it then follows that there is no point in having a particular man drive a particular truck each day. In our experience, we have found that permitting approximately half of the operators to choose their vehicles and having the foreman assign the other half results in the best conditions. Of course, the ones permitted to choose vehicles and those specifically assigned are rotated from day to day. The object of this maneuver is to prevent any man from feeling that he has a vested interest in any particular vehicle and at the same time insist that all operators show evidence of interest in whatever vehicle they may drive.

We find it advantageous to have our vehicles arranged in an orderly fashion at the change of turns. To gain the complete end which is desirable in setting up this organized turn changing procedure, it has been found advisable to have a spotlight for each truck, to shine on the engine for oil and water inspection at night. In addition to this, each truck is provided with a good extension cord light which will go all the way around

the truck and reach any part of it. This arrangement affords the men who are working on the night turns the same facilities for their inspection work as those who are working on the day shift. Operators coming into work are given time enough to examine the units they are going to drive. In this manner, the operator assumes complete responsibility for the condition of the vehicle when he drives it away from the dock and places supervisors in a position where they can hold the operator responsible for whatever may happen to his vehicle during the course of the turn. This procedure applies particularly to crank case oil level, radiator water level, condition of tires as related to cuts and as to any damage which may occur to other parts of the vehicle. If the operator does not point out the various deficiencies of the vehicle to the foreman before he takes it away from the dock, it is assumed that he has caused the damage.

This method removes most of the operator's alibis and prevents him from blaming it on the other turn. No limit is placed on the time the operator spends on this feature of his work, but the small amount used for these purposes is well spent. This organized turn changing procedure was first set up for the equipment which was assigned to our Gambrinus plant. With the completion of a new private road from the Canton plant it has been found to be worthwhile to have the crews from both plants change turns at one given point. The gain comes from a better maintenance control set up. It is sometimes difficult to create an operator interest under today's conditions, but it can be done if supervisors and maintenance people recognize the operator's rights and prerogatives to have a properly equipped and properly maintained vehicle for him to operate. We feel that if on one hand the management says the man must do a good job of operating, it follows on the other hand that management has an obligation to furnish tools and vehicles with which an operator can do a good job. When this level is reached, the pay off comes in rather large proportions.

TWO-WAY RADIO

Some means of communication is necessary in any organized activity. This often becomes a problem with the maintenance of materials handling equipment, especially when the distance involved removes the equipment from the line of sight, and time is the important element. Two-way radio has been important in developing adequate contacts for field repairs. Thus, in the direction of our vehicles, the radio dispatcher becomes the contact point for the handling of information relative to "in the field" repair requirements and thereby enables us to expedite such services. Likewise the dispatcher has before him at all times, a vehicle servicing record which permits him to dictate daily or weekly servicing requirements to the various operators.

AUXILIARY EQUIPMENT

We found sometime ago that certain types of breakdowns were quite costly as related to the cause of the breakdown. Batteries and other supplementary equipment for internal combustion engines constitute the class of material which we feel is in a measure, inadequate for industrial applications. After some investigation, we invited one of the major battery manufacturers to make a survey of our battery usage and to recommend the types of batteries which they felt were needed to eliminate all possible battery trouble encountered in our operation. We have followed their recommendations and are happy with the results. Formerly, it was not unusual to put a new battery into a straddle truck in the evening during the winter season and find it completely exhausted by morning, but with our present setup, we hardly know what battery trouble is.

The whole point is, that industrial usage requires something more than competitively priced automotive type equipment. This leads us into other internal combustion engine appurtenances. We think it is profitable to remove coils, condensers, fuel pumps, etc. in order to replace them with the best items of this kind which the market affords. It is actually profitable to replace and throw these things away rather than put up with the costly annoying shutdowns which occur because of their inadequacies. Materials of this class seem to be reasonably adequate on our own personal automobiles for which they are commonly created. They are definitely inadequate in the heavy industrial picture to which we are referring. We do not present this as an indictment of the automotive industry. We do feel that certain recognition must be accorded to heavy industrial situations by the manufacturers of mobile equipment. We further feel that the small price advantage which can be obtained by the use of these cheaper items is more than lost by the bad name which they give to automotive type equipment in heavy industry. It might be well if the manufacturers of mobile equipment would give some consideration to situations of this type.

SUMMARY

To summarize the picture briefly, it would seem that a program to facilitate the maintenance of material handling equipment for the steel industry would implement conditions of uninterrupted operation, interdepartmental coordination and development of good working conditions. Problems of varying degrees may arise from situations that are peculiar to a given plant

Figure 8 — General view of main repair shop where most of the mobile equipment maintenance is accomplished. Spare parts storage is at the right.

or district. However, the basic principles of such a program cannot vary to any great extent throughout the industry because they are dictated by the same basic requirements of production and delivery. We feel that in adopting this plan of maintenance we have been able to assist in accomplishing these requirements without creating counter sacrifices.

PART II

By JOHN C. LANTZ
Maintenance Foreman
Steel and Tube Div.
The Timken Roller Bearing Co.
Canton, Ohio

WORK PLACE AND PERSONNEL

Our plant operations are such that materials handling services are usually required on a twenty-four hour-seven day per week basis. Maintenance schedules for materials handling equipment consequently are on a twenty-four hour day basis also. By assigning a portion of the work force to a rotating schedule we are able to provide this twenty-four hour service. Mechanics who are working on this schedule are required to carry out routine maintenance of equipment, while they are simultaneously on call for any emergency service. The remaining maintenance personnel are assigned to day shift work because of the normally greater activity on this shift and the added availability of related services such as machining, welding, etc.

The principal mobile equipment repair shop is a 40 × 180-ft quonset type building with a centrally located railroad track and servicing pit. See Figure 8. Since 1946 this building has been expanded in size twice, from 40 × 80 ft to its present size. This dramatically indicates the great expansion during those years of our material handling services. Maintenance work including servicing, rebuilding of equipment, replacing of engines, transmissions and clutches, and scheduled preventive maintenance is performed in this building. In addition, this building also houses a spare parts room, engine and unit repair room and facilities for tire and battery servicing.

Maintenance men in the materials handling department are trained to cope with a wide variety of maintenance problems. Since the job demands an unusually high degree of skill, applicants for these jobs are screened by our personnel department and are required to pass mechanical aptitude, reactionary, and depth perception tests along with the ordinary conditions of employment. Once hired, the maintenance applicants are closely supervised and are assigned to work with experienced mechanics until they have satisfied their supervisors of their competence.

HANDLING OF SPARE PARTS

To eliminate unnecessary downtime of equipment and to utilize to the maximum the maintenance mechanics' work period, an adequate supply of spare parts is carried in our maintenance inventory. Each mechanic is trained in the proper control of this inventory. Our spare parts store room is operated on what might be called an "open" system, whereby any mechanic can obtain a necessary part at any time without the assistance of his supervisor or a parts man. This is accomplished by combining a complete spare parts index with a perpetual inventory system. See Figure 9.

Actually, the mechanic needs do nothing more than check the parts catalog of the manufacturer to determine the desired parts number and then refer to this parts number in the file to ascertain the storage location of the part. Having found the required part, he removes an identification tag and deposits it in a tag box. This tag has been marked with pertinent data relative to the part so that when the parts man collects the tag he has complete information relative to the withdrawal and replacement. This simple routine is carried out in every instance in which a required part bears the

Figure 9 — Parts control area in repair shop is shown. Parts books, at upper left and file cards at lower left, provide mechanics with key to location of parts in the bins at right.

Figure 10 — Spare parts for any kind of breakdown are carried in these bins to insure early return of repaired vehicles to their assigned work.

Figure 11 — Straddle carriers are serviced by mechanics and operators every 150 to 175 operating hours. Grease and oil supplies are at left.

manufacturer's part number. It can readily be seen that the physical aspects of this system develop a familiarity with the spare parts and eliminates red tape and time wasted by "digging in the barrel." It also is apparent that the confidence thus placed in the mechanics makes for a better job attitude.

The parts man makes inventory records of incoming and outgoing parts, keeps a diary account of repairs and posts the tire, battery, clutch and general servicing information. He is required to physically check all incoming parts and see that tags are applied which carry all the information necessary to the functioning of the system. In this manner the paper work becomes a controlling factor in this system, but remains minimized due to the automatic nature of its operation. Actually, one parts man working a forty-hour week, adequately controls the system. In other words, the success of this system is a result of the proper filing and orderly storing of parts and proper training of personnel.

Many factors dictate the physical structure of a spare parts room or building. Likewise, expansion and experience may dictate alterations. Our spare parts room

Figure 12 — Data illustrated is used to compose records of vehicle performance and furnish information relative to tires and other pertinent parts.

Daily Truck Sheet Dept. 100 Date: 7-30-54 Shift: 3 Roanoke Rome and Co. C. Young 100-200

Equip. No. & Type	Job Performed		Man Hours	Tire Off	Tire On	Battery In	Battery Out
No. 2 Str.	Tighten battery case		1/4				
No. 12 Str.	Replace Hydrovel air filter and tighten floor boards		1/4				
40 Lil.	Go to Canton and replace hydraulic hose		1/2				
No. 12 Str.	Replace right rear tire	3450 hours	1/2	1351	1348		
No. 27 Lil.	Replaced battery	183 hours	1/4			129	143
35 Lil.	Remove left front wheel and brake assembly Replace brake blocks and top wheel cylinder		3				
51 S. L.	Changed oil and serviced	4193 hours	3-1/2				
33 Lil.	Repaired shifter lever and replaced right rear wheel lug		1-1/2				
	Lunch		1/4				

is made of steel cupboard sections, 36-in. wide, 84-in. high and varying in depth from 12 to 36 in. A portion of these sections is subdivided into bins of varying sizes and another portion into drawers, some of which are again subdivided into compartments. (Figure 10). The filing system is accommodated by six visible type filing cabinets, each containing eighteen drawers and each drawer holding eighty inventory cards. Inventory cards are filed in numerical order under the equipment manufacturer's part number.

We carry an estimated fifty thousand dollars worth of spare parts including about one thousand dollars worth of pilferable parts such as various types of lights, generators, spark plugs, starters, etc, and as we have previously stated, one man is on duty in the parts room on day turn only, five days per week. We have learned from experience, however, that our losses in these parts would not justify the added payroll expense of additional personnel for merely a police coverage.

WORK SCHEDULING

Each of our mobile units is equipped with an engine hour meter which records the accumulated operating hours. This meter works off the ignition system and records only during the time the ignition system is in use. We have found this to be a simple and trouble-free meter and a very essential accessory in the scheduling of servicing and the compiling of maintenance records.

Servicing is normally scheduled on a 150 to 175 operating hour basis depending upon the availability of the equipment and the work load. Routine servicing would not ordinarily seem to be a complicated problem, but it can often become involved when you are committed to uninterrupted operation. For example, the supervisor when completing his day leaves instructions covering repair work or servicing with the mechanics working on the night shifts. Thus the responsibility of making arrangements to do the work is placed directly upon the mechanic. His servicing work on a particular unit may require from two to four hours depending on the extent of adjustments and repairs upon the component parts of the unit. This servicing includes changing of oil and filter cartridge, checking gear cases, battery, ignition and fuel systems, and some twenty other vital points of lubrication and adjustment. We do not maintain a check list as such, but provide the mechanic with a guide which places the responsibility of the service job on him. We find that this system induces the mechanic to do a thorough job because he realizes that our confidence has made him a vital individual in the organization.

To facilitate the keeping of equipment records we have adopted a daily work sheet (Figure 12) which each mechanic is required to fill out at the end of his turn stating the equipment number, nature of the repairs and the amount of time spent on each job. This information is later posted in our equipment dairy and gives us valuable data for analyzing types of breakdowns and computing the ratio of mechanic repair time to operating time.

Our mechanics furnish all their own hand tools. We make available to them such company-owned tools as electric drills, grinders, tap and die sets, compression gages, drill bits, ¾-in. drive socket sets, electric im-

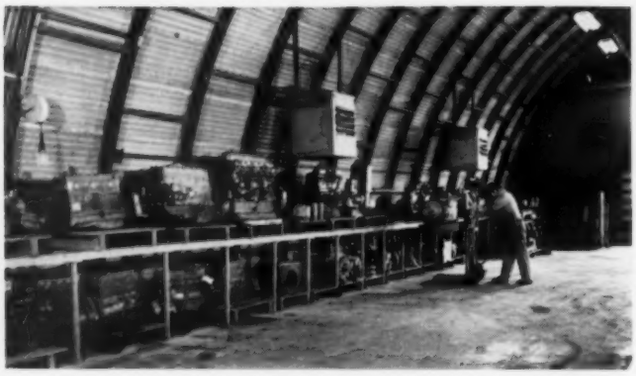


Figure 13 — Repaired and reassembled engines, differentials, transmissions and other units are stored in readiness for installation when needed.

Figure 14 — Mounted and inflated tires of all sizes cut down the time required to restore trucks to service in cases of flat tire.

pactors, pullers, volt and amperage testers and various special tools peculiar to certain types of equipment.

The department uses a four-wheel drive, radio equipped pick-up truck for all field repairs within and between our Canton and Gambrinus plants, and for necessary towing of equipment to the repair shop for major repair work. The supervisors, through the dispatchers, are able to maintain radio contacts with the mechanics in the field and direct their efforts to the best advantage.

As in the case of servicing, uninterrupted operation also dictates the scheduling of our equipment repairing. It may mean the postponement of a repair job until a replacement unit is available, and such a postponement may result in much more extensive repairs in the end, but it will also provide for unbroken service to vital plant operations.

An adequate supply of spare assemblies has also enabled us to minimize repair work downtime. The replacement of entire engines, transmissions, differentials, or hoisting assemblies not only reduces the downtime but also enables us to methodically make the repairs on the replaced assemblies.

If and when we find ourselves in an over-burdened maintenance situation, we gain relief by assigning engine rebuilding work to local service firms. However, it is our objective, in so far as possible, to accomplish our work with properly trained personnel of our own.

Due to the type of work our material handling department is expected to do, we often encounter equipment engineering difficulties which would not develop in ordinary automotive equipment usage. In other words — we are asking the equipment to undergo punishment for which it was not intended nor designed. This is not done because of carelessness nor operator abuse, but because the operation is efficient despite the extremely high maintenance. Equipment subjected to such grueling schedules inevitably breaks down through failures of clutches, crank shafts, brakes, etc. In ordinary practice a mechanical failure can be analyzed from three standpoints — human failure, wear and tear, and limitations of design. Human failures can be controlled by operator training. Wear and tear can be minimized by preventive maintenance and anticipation. But limitations of design must be accepted until altered to accommodate a particular application. Our operation demands many such special applications and through the cooperation of various equipment manufacturers we have been able to secure some changes in design which have benefited our materials handling program appreciably.

PNEUMATIC TIRES

Pneumatic tires are a vital factor in our continuous materials handling system. We use 190 rolling pneumatic tires of various sizes ranging from a 400 × 8 mobile power wheelbarrow tire to a 1600 × 24 tire used on four-wheel drive shovel loaders. We carry mounted and unmounted spare tires and tubes to accommodate each piece of equipment. Tire changing and minor tube and casing repairs are made in the department. The more extensive casing repairs and retreading are assigned to a local tire firm.

In order to maintain control over these tires and their turnover, we brand a number on each tire when it is received, and then set up a performance record in the file under that particular number. When a flat tire is removed and replaced, the mechanic makes a note of the vehicle number, location of tire on the vehicle and the hour meter reading along with any other pertinent information. This information is incorporated into his daily work report sheet from which the parts man posts the necessary information on the record cards of the respective tires. Complete histories of locations, mileages and repairs are compiled on these cards which help evaluate various tread and casing designs. As a matter of fact this type of tire history recording has been instrumental in persuading a well-known tire builder to produce a tire of heavy sidewall construction exclusively designed for straddle truck usage.

SAFETY

An equipment painting program is followed whereby a piece of equipment of one type or another is cleaned and painted every other week by the company painting department. A uniform color scheme is employed in which a bright, easily discernible orange is predominant. Color requirements are included in the specifications of newly ordered equipment.

As a safety measure on our equipment which often works over and around hot steel and furnaces, we have installed vented top fuel-tank outlets. This type of top outlet will prevent a tank from draining itself in case of line breakage and the 0.017 vented opening at the tank elbow will prevent the tank from syphoning itself dry. To compensate for this vented opening it was

necessary to install electric fuel pumps which furnish an adequate supply of fuel to the engines.

The mechanics use a portable, elevated safety platform for working on the upper portions of straddle trucks. This eliminates ladder reaching and monkey climbing.

When remounting repaired tires, a device is placed in the rim which prevents the lock ring from blowing off during inflation.

Proper guards are required in all instances where moving parts of equipment or tools present hazards. Personal safety equipment and clothing are provided wherever necessary. Safety instructions, literature and supervisory follow ups are a part of each employee's training. Supervisors are held responsible for a perpetual effective safety program.

SUMMARY

Supervisory decisions necessary to conduct such a maintenance system can and should be influenced in some instances by operator's comments or complaints. It costs nothing to listen to a gripe and it might be a constructive one. An attentive ear by a supervisor (or the dispatchers) in an effort to remedy the complaint will create a feeling of satisfaction in the operators and causes them to rely with confidence on the people who keep their equipment in shape. It is obviously desirable to build a cooperative morale founded upon confidence. There are many approaches to this goal but none are successful without a consideration of human reactions. Man is a rational intelligent being. It would be reasonable to expect that operating attitudes can be shaped through these same processes.

DISCUSSION

PRESENTED BY

L. RUSSELL ASTIE, General Maintenance Dept., Jones and Laughlin Steel Corp., Pittsburgh, Pa.

R. H. GRAVES, United States Metals Refining Co., Carteret, N. J.

L. Russell Astie. Every phase of human activity has its leaders, people who lead the way, whom we know as pioneers. Those of us who have known Frank Wier during the past ten or twelve years recognize him as a pioneer in the adoption of mobile equipment for handling and transporting material in a steel plant. What Mr. Wier and his organization have accomplished at Timken Roller Bearing Co. has been patterned in many ways in plants throughout the industry. Perhaps it will be well, as a sort of refresher, for us to review just a few of these accomplishments.

Mr. Wier was one of the first to use crawler type tractors for the removal of slag from open hearth furnace slag pockets. It was back in September, 1942, just twelve years ago, that a group of us went to Canton, Ohio, to see this operation. At that time, we not only saw the tractor removing slag, but we saw the slag being loaded directly into highway trucks and hauled to the dump.

The use of crawler tractors for removal of slag from open hearth pockets has become quite general throughout the industry. In our plant, the Pittsburgh Works of

Figure 15 — Straddle carriers using a special platform carry small solid tired fork lift truck to the repair shop instead of running it over slag roads.

Jones and Laughlin Steel Corp., it has become an indispensable tool in dismantling open hearth furnaces for repairs. Our problem is in getting bigger and stronger machines for the job.

Mr. Wier was the first to use a grade-all unit in connection with open hearth furnace dismantling. In our plant, we use the grade-all to scrape out the furnace body in the dismantling of the furnace roof, frontwall and backwall.

Mr. Wier was one of the first to use front end loaders for unloading bulk materials from hopper cars to stock, and for reloading from stock to car or truck.

Mr. Wier's pioneering in the adoption of straddle trucks for steel mill use is well known throughout the industry. Most people might be inclined to attribute the success of this operation to the abundance of space for the movement of straddle trucks as well as large storage areas for material storage. I am inclined to give the credit to initiative and interest in the job.

Now, there is another first in connection with Mr. Wier's material handling interests. It looks as though he is the first superintendent of material handling in a steel plant — that is, with the specific title, as such — with a full line organization, as shown by the organization chart on Figure 1. If this pioneering in the use of mobile equipment had not paid off, no doubt the material handling organization at Timken would not be in the position shown by this chart. Therefore, it is to be expected that an aggressive organization of this type should be one of the first to develop a systematic setup of shop facilities and maintenance policies to insure maximum availability of mobile equipment on an economical maintenance basis. We could term this as aiming toward full utilization of equipment. Full utilization of equipment, provided the equipment is properly selected, depends upon where the maintenance responsibility starts, as well as how it is performed.

We in the maintenance department know that maintenance starts with selection of the equipment. Equipment not suitable for the job is handicapped right from

the start. Next in importance is proper selection and training of operators. Perhaps most of us do not feel we should spend the time and effort necessary for setting up definite operating and training programs and policies. If we have not already found it out, we will sooner or later find out that it will pay big dividends in improved operating conditions and lower maintenance costs.

Along with suitable equipment and properly trained operators, we must have adequate repair and servicing facilities. The setup of proper handling equipment, well trained operators, and adequate repair facilities is rapidly becoming a must. A well trained supervisory organization for both operation and maintenance of material handling equipment also appears to be a logical arrangement to control the tendency of constantly increasing costs of repair labor and repair parts.

Adequate historical records of repairs, as well as stock records of spares, is certainly a must. The storeroom and record setup shown of Timken facilities is worthy of duplication by any plant having mobile equipment. We have many of these features at the Pittsburgh Works general maintenance tractor garage. However, most of the facilities are scattered at various locations, and entirely inadequate for efficient functioning.

Maintenance of mobile equipment in a steel plant is getting to be big business, which runs into more money than most people realize.

I agree with Mr. Wier that the skill involved in maintenance of mobile equipment is a specialized job. In our plant, we train our own mechanics. We pick an operator who shows an inclination for repair work, make a repairman helper out of him and then, through job seniority, he develops into a repairman.

Only those directly involved in the use and maintenance of mobile equipment realize the importance of adequate spares on hand. The lack of a spare part costing only a few dollars can cause some prolonged periods of embarrassment and result in heavy increases in costs as well as losses in production.

Two-way radio, where it can be properly used by a central dispatch system, certainly pays off in equipment utilization. We have it on some of our highway trucks. It ties them to the truck dispatcher for intra-plant movement of material.

With the proper cooperation and the right attitude on the part of management and supervision, much can be accomplished to improve the performance of mobile equipment in steel plants through a more adequate program of maintenance, such as was described by these speakers this morning.

We should not only compliment the Timken organization for the fine job of maintenance that they are doing, but those of us who do not already have a setup of this kind should follow their lead so far as we can apply it to our respective plants.

R. H. Graves: In order to accomplish a setup such as described, either the men at Timken have more "know how" than we at U. S. Metals or else they have a different union. I at least know the latter to be true.

We also would like to have all mobile equipment maintenance under the material handling department head. We also desire to have all mobile equipment under the material handling department head. Timken has accomplished both of these desires. We have failed on both of them. Both failures are due to our inability to convince the union that there must be some fair way to overcome the employee seniority problem. Undoubtedly others have had or will have the same problem.

This two-fold problem in our plant stems from the fact that:

1. Various departments in our plant have owned and operated industrial trucks for years before we had a plant wide material handling department. These trucks were semi-serviced by a departmental handyman and hauled to the mechanical department when repairs are needed. The time to have taken these trucks and operators into the material handling department fold was when we started. But six months of arguing failed to dent the union, so we went ahead. Now the problem is more difficult.
2. Because our mechanical department had been repairing these trucks as well as standard gage diesel equipment and narrow gage gas equipment for over thirty years, they still claim it is their right to do so. To date we have not been able to make the change and set up a new department under the material handling supervision.

The Timken spare parts setup works like a charm but did you hear that $50,000 figure? There are other ways to at least partially keep this figure down but it depends upon your geographical location. We have tried for years to outguess the equipment in question as to what was going to need replacing next and have not done too well. In these days of industrial truck equipment mergers, advanced equipment appearing on the market and models being dropped, it is easy to be forced to keep an obsolete truck just to use up the basket full of spares you have been carrying which are probably the wrong ones anyway.

In northern New Jersey, where industrial truck distributors are practically on every corner, each with a room full of spares, we believe it to be more economical to carry spare trucks instead of spare parts. This, of course, is not true where we only have one of a kind such as a travel loader or dumpster or one of the largest fork trucks built.

I would also like to add a word in regard to vehicle operators. We feel about the same way that Timken does about them. We give them cabs, heaters, fans, extra windshield wipers and even an awning over the left door so they will not get wet or sun burned. They are the absolute boss of whatever vehicle they happen to be driving. We pay them a little more than most people think necessary, but the last new truck driver we made required 19 years plant seniority to get the job.

We differ from Timken in operator requirements in that due to the past practice statement in our union contract, an operator cannot repair or help to repair a truck. He does keep it clean except for any grease or dirt left by mechanics. Mechanics are supposed to wipe off any grease or dirt which they have placed on the vehicle before releasing it to an operator.

We keep a check list on all vehicles due to the maintenance of vehicles from departments other than the material handling department. This helps to point out to them that they must release their equipment for maintenance as often as the material handling department does.

PROGRAM

AISE

SPRING CONFERENCE

AUSPICES

OF

ROLLING MILL COMMITTEE

HOTEL STATLER

DETROIT, MICH.

APRIL 25, 26, 27, 1955

MONDAY, APRIL 25, 1955

8:30 am — Registration — Ball Room Foyer

9:00 am — ROLLING MILL SESSION — Wayne Room

"Reversing Hot Strip Mill . . . Its Place in the Steel Production Facilities," by David Lyle, Vice President, Continental Foundry and Machine Co., Pittsburgh, Pa.

"Meeting the Metallurgical Challenge in Rolling Stainless Bars," by P. T. Reynolds, Assistant Superintendent, Bloom, Billet and Bar Mills, Republic Steel Corp., Massillon, Ohio and H. F. Kaiser, Assistant Superintendent, 35-in. Blooming Mill, Republic Steel Corp., Canton, Ohio.

"Basic Formulas for Roll Design and Rolling Alloy Steels," by A. M. Cameron, Superintendent, Blooming and Bar Mill Dept., Atlas Steels Limited, Welland, Ontario, Canada.

9:00 am — Mechanical Session — Michigan Room

"A New Approach to Continuous Mill Drives," by Astor L. Thurman, Executive Vice President, Mannesmann-Meer Engineering and Construction Co., Inc., Easton, Pa.

"Composition Bearings Used in Rolling Mills," by Kenneth E. McHenry, Assistant to Superintendent, Mechanical Dept., Lackawanna Plant, Bethlehem Steel Co., Lackawanna, N. Y.

"Roll Neck Lubrication," by Herman C. Inlow, Research Chemist, Cities Service Research and Development Co., East Chicago, Ind.

2:00 pm — Rolling Mill Session — Wayne Room

"C. F. and I. 3-Strand High Speed Rod Mill," by V. W. Johnson, Superintendent, Rolling Mills and Finishing, Colorado Fuel and Iron Corp., Pueblo Plant, Pueblo, Colo.

"Design and Installation of a Multi-purpose Hot Rolling Mill," by A. A. Britton, Jr., Vice President—Production, Carpenter Steel Co., Reading, Pa.

"High Speed Rod Rolling at Continental Steel Corporation," by Don C. Horsman, Assistant General Superintendent, Continental Steel Corp., Kokomo, Ind.

2:00 pm — Electrical Session — Michigan Room

"New Concepts in Drive Systems for Hot Strip Mills," by R. J. Moran and H. N. Snively, Steel Mill Engineering, Industrial Engineering Section, General Electric Co., Schenectady, N. Y.

"Application of Power Data in Selection of Rolling Mill Drives," by A. F. Kenyon, Steel Mill Engineer, Industry Engineering Dept., Westinghouse Electric Corp., East Pittsburgh, Pa.

"Induction Heating in Tubemaking," by S. O. Evans, Manager of Tubing Operations, Babcock & Wilcox Co., Tubular Products Div., Beaver Falls, Pa.

TUESDAY, APRIL 26, 1955

9:00 am — Rolling Mill Session — Wayne Room

"Roll Grinding," by William Pope, Factory Representative, National Grinding Wheel Co., Inc., Gary, Ind.

"Surface Inspection of Hot Rolled Coil Rods and Bars," by William C. Campbell, Assistant Superintendent, Merchant Mills Campbell Works, Youngstown Sheet and Tube Co., Youngstown, Ohio.

"An X-Ray Tin Thickness Gage for the Electrolytic Tin Line," by R. R. Webster, Assistant Manager, Metallurgical Research, Jones and Laughlin Steel Corp., Pittsburgh, Pa.

9:00 am — Combustion Session — Michigan Room

"The Application of Tunnel Type Furnaces to Steel Mill Use,"

Part I — **"Mechanical Features and Material Handling,"** by J. T. Cook, Assistant Chief Engineer, Steel and Tube Division, The Timken Roller Bearing Co., Canton, Ohio.

Part II — **"Heating and Combustion Features,"** by D. R. Baker, Combustion Engineer, Steel and Tube Division, The Timken Roller Bearing Co., Canton, Ohio.

"Application of Rotary Hearth Furnace for Heating Plate Mill Slabs," by F. C. Schoen, Chief Engineer, Alan Wood Steel Co., Conshohocken, Pa.

"New Annealing Facilities for Ford Motor Company's Steel Division" by John Sprague, Fuel and Utilities Engineer, Ford Motor Co., Steel Div., Dearborn, Mich.

2:00 pm — General Off-the-Record Round-table Discussion — Wayne Room

Topics will include roll breakage, water cooling of rolls, slivers in rod production, guide materials, finishes for roll necks, strip edges, stationary vs rotating coiler mandrels, mill spindles, pit cranes, blooming mill manipulators, etc.

7:00 pm — Informal Stag Dinner — Grand Ball Room

Speaker: A. E. Kadell, Senior Vice President, Great Lakes Steel Corp., Ecorse, Detroit, Mich.

PLANT VISITS

Great Lakes Steel Corp., Ford Motor Co. and Rotary Electric Steel Corp. have kindly granted permission for individuals attending this meeting to visit their plants on the way to or from the meeting.

Details on this may be obtained by contacting the Detroit District Secretary, O. P. Ashurst, 1000 Marquette Building, Detroit 26, Mich., telephone WOodward 1-2084.

WEDNESDAY, APRIL 27, 1955

8:30 am — Inspection Trip —

Great Lakes Steel Corp., Ecorse, Detroit, Mich. Buses leave from Hotel Statler.

HOTEL RESERVATIONS

For hotel reservations, write directly to the Hotel Statler giving time of arrival, type of accommodations desired and period of stay. Reservations should also state that they are for the 1955 AISE Spring Conference.

Ore boat slides past the Detroit sky line on way to Great Lakes Steel Corp. plant at Ecorse.

A Symposium on Material Handling in the steel plant

. . . . improving efficiency of material handling in steel plant operations is essential in cutting costs . . . . unfortunately, present plants and existing capital assets make it impossible to attain the ideal layout from a material handling standpoint . . . . improvements at Ford illustrate an excellent and ingenious approach to the problem . . . .

PLANT LAYOUT

By G. LEE BERRY
Plant Engineering Dept.
Steel Division
Ford Motor Co.
Dearborn, Mich.

▲ THIS paper is intended primarily as a discussion of the material handling aspects of our recent modernization program, but it is important to explain that the program relative to modernization of the material handling facilities has, of necessity, been importantly influenced by conditions existent in the Ford steel mill, which are not unlike those currently existing in many other steel mills throughout this country.

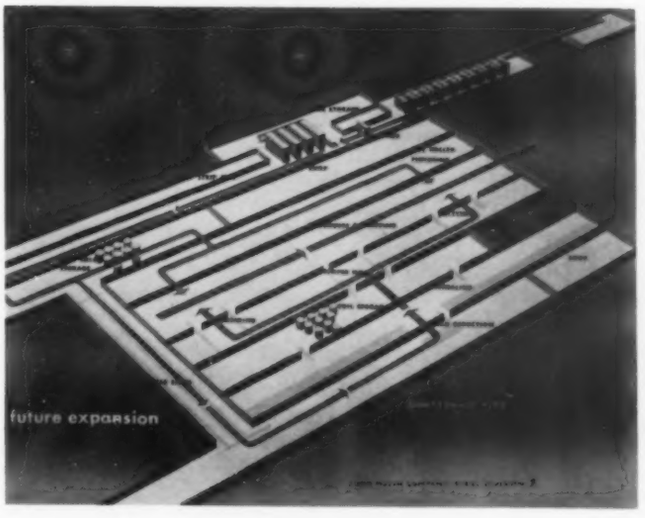
Most men are aware of the large investment that is necessary in order to install the basic facilities required to produce, to process and to finish steel. Once that initial investment has been made, it is economically unsound to scrap those facilities so that an ideal plant can be built, which will incorporate every modern material handling improvement that might be included in a new mill.

So in a sense, this paper deals primarily with the adaptation of certain fundamental concepts of modern up-to-date material handling methods—to an existing facility in order that, with a minimum of additional capital expenditure; competitive operating conditions may be attained.

Briefly, the approach to the problem at Ford has been a dual one; namely,

1. To modernize our material processing, coiling and handling facilities in order that they might accommodate the processing and transportation of larger units; that is, larger ingots, larger slabs and larger coils.
2. To employ the principles of automation wherever conditions permitted and the cost savings attainable warranted the expenditure.

Figure 1 — An ideal layout for a steel plant producing flat products is illustrated in this sketch.



These, in short, are the specific aspects of "material handling" which will be covered.

MODERN HANDLING FOR SHEET AND STRIP MILLS

Immediately after World War II, new technological improvements were developed which permitted the steel industry to undertake extensive modernization of sheet and strip processing facilities. Examination of these new industry developments in flat rolled processing shows that few basic manufacturing changes have been made.

The trend in new plant design is toward a straight line flow from the open hearth through the finishing operation, and the production of larger units at higher speeds, starting with ingots and carrying through the subsequent operations.

In new plants, ingot stripping facilities are normally located close to the soaking pits to reduce heat losses, and new layouts are providing for direct rolling from the soaking pits through the slabbing and strip rolling operations. Although considerable advancement has been made in direct rolling; slab reheating facilities are still required to meet operating and rolling schedules.

Figure 1 shows a material flow layout of a typical strip processing plant. Note the proximity of ingot stripping to rolling operations, straight-away flow from soaking pits through the slabbing and continuous strip mill. Note that provisions are made for slab storage and reheating. The layout is conducive to floor level type of mechanical conveying of coils to the hot coil storage area, pickle lines, cold reduction and finishing operations.

The layout of material handling for the hot strip mill coil storage is presently being integrated with the finishing operations. Current normal operating and scheduling practices require that approximately 13 turns of production be stored. This area must be designed for the maximum selection of product with minimum of damage and cross handling.

A maximum of one or two turns of production of pickled coils are stored ahead of cold reduction in order to better maintain control of quality and welding. Storage areas for annealing vary considerably, depending on the type of product, size of coils, and facilities for cooling. The storage areas are inter-connected by conveyors; and the processing units are provided with storage conveying equipment. Pallet type conveyors have proved most successful—ramp type and roller conveyors are not recommended.

Material handling for these storage areas require careful study of material flow and production requirements, in order to avoid costly product handling and damage. It is estimated the material handling cost to process finished cold rolled strip from ingots represents about one-third the total manufacturing cost above material.

Accompanying this trend in plant layout to achieve greater efficiency of operations, stress has been placed on the production of larger units at higher speeds.

Speeds of processing equipment have steadily increased to the point where we now have designs for pickle lines up to 600 fpm, cold reduction strip mills 3000 fpm, and over 6000 fpm for light gage products; temper mills at 3500 fpm, and shear lines over 1000 fpm.

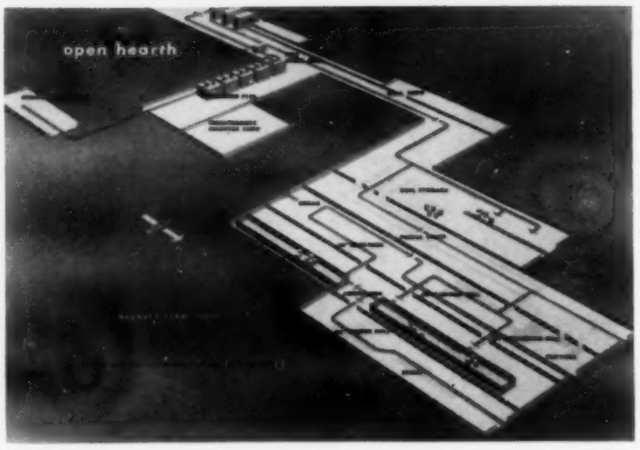


Figure 2 — Layout shows material flow at Ford plant.

In order to obtain efficient use of the high speeds, large coil practices and material handling equipment have been developed. Handling improvements on the processing units have taken the form of increased in-process sizes and reduction of charging or preparation time, both of which tend to make sheet processing more continuous, and permit a higher utilization of power and speeds. The standard generally accepted by the industry for cold reduced strip coils is 24 in. inside diameter to 72 in. outside diameter, weighing up to 50,000 lb. This standard was adopted by reason of practical equipment design, product mix, floor loadings, and minimum damage to product.

The benefits to be gained from large coils and improved charging time at cold reduction mills and other processing places requires individual engineering consideration of each unit in the design of facilities. For example the development of high speed cold reduction mills up to 3000 fpm, for processing sheet products in large coils required that particular attention be given to the design of the coil handling and conveying equipment to and from the mill.

Coil size and coil charging time have a significant effect on mill capacity, particularly at higher speed. This may be shown by comparisons of mill speeds, coil sizes, and charging times for 20-gage product, 48 in. wide.

By increasing the coil size from 20,000 to 40,000 lb based on 1.5-minute charge time (without delays), the efficiency per mill rolling hour can be increased 9 per cent at 500 fpm; 16 per cent at 1000 fpm, and 30 per cent at 2000 fpm.

By reducing the coil charge time from 2.5 to 1.5-minuates based on rolling 40,000-lb coils (without delays), the efficiency per mill rolling hour can be further increased 7 per cent at 500 fpm; 12 per cent at 1000 fpm and 21 per cent at 2000 fpm.

Stated in terms of mill speeds, the same theoretical efficiency can be obtained by an 1100 fpm mill, rolling 40,000-lb coils with a 1.5-minute coil charging time as can be rolled by a faster mill (1300 fpm) on the same coil size, but a 2.5-minute coil charging time, or a mill of 2500 fpm, rolling 20,000-lb coils with a 2.5-minute coil charging time.

These examples are intended to show the interde-

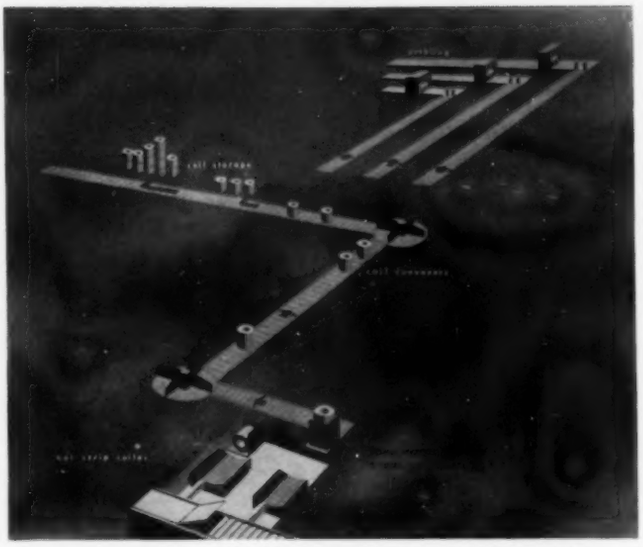


Figure 3 — Conveyors are extensively used in moving of coils.

pendence of coil size, charging time and mill speeds. The high cost of handling facilities involved in doubling the size of cold rolled coils yields a relatively small increase in efficiency, unless it is accompanied by the greatest possible reduction in coil charge time and an increase in speed. Conversely, the benefits of costly equipment to increase speeds are relatively small without an accompanying improvement in more continuous processing methods.

The high speed mill highlights the need of critical and efficient quality control due to the volume of defective material, which can be processed during a short interval of time. To process a prime cold rolled sheet, with today's practices, requires that approximately 40 per cent more steel be made than is actually finished, due to the processing losses.

The efficiency of the modern mill is being continually improved by the use of larger packages, better handling and flow of material; and will continue to improve through development of better rolling and scheduling practices, product yields and standardization of in-process and finished materials. In the past ten years, coil size has been increased over 100 per cent which for an equivalent production reduces the number of coils to be handled by one-half. Currently mills are designed to produce and handle over 20,000-lb hot rolled coils and 50,000-lb cold rolled coils.

Technical developments such as these are of vital importance in a decision to modernize an old plant. They require appraisals of the existing situation and development of plans to determine whether the old plant can be made competitive before the proposed program is undertaken.

The application of these new industry developments to an old plant and the appraisal of the relative position of a modernized old plant as compared to a new installation, are illustrated by the recent modernization program of the Ford steel mill. The original strip processing facilities at Ford were installed in 1935, basic iron and steel making facilities were installed in 1918.

The program undertaken in 1951 had as its objective the economic balancing of coke, iron, and sheet steel production, and modernization and replacement of existing equipment to bring the total output to a level of competitive efficiency. It was necessary to provide a greater utilization of present facilities, and to improve material flow to eliminate excessive handling and transportation of materials in process.

When the balanced capacity for steel strip and foundry iron and coke requirements had been determined, the facility improvements for producing coke, pig iron and ingot melt to balance the sheet capacity were planned. Thirty-seven additional coke ovens were installed adjacent to the 183 oven plant. New coke screening facilities were installed and the by-products plant rehabilitated.

Iron production was rounded out by the installation of a new 1500-ton per day sintering plant for conditioning ore, flue dust, and mill scale to provide a high metallic charge for the blast furnaces.

Figure 2 shows the material flow layout of strip processing at the Ford mill. Note the layout of ingot stripping with relation to the soaking pits. Direct rolling of slabs from the blooming mill is accomplished by cross conveying rather than in line facilities, and by flow of slabs through reheating furnaces. Provisions are made for a minimum of slab storage. The layout provides floor level mechanical conveying of coils to: the hot coil storage area, pickle lines, cold reduction, annealing and finishing operations. A direct comparison

Figure 4 — Flow from pickling through the 66-in. tandem mill to the annealing furnaces is shown in this sketch.

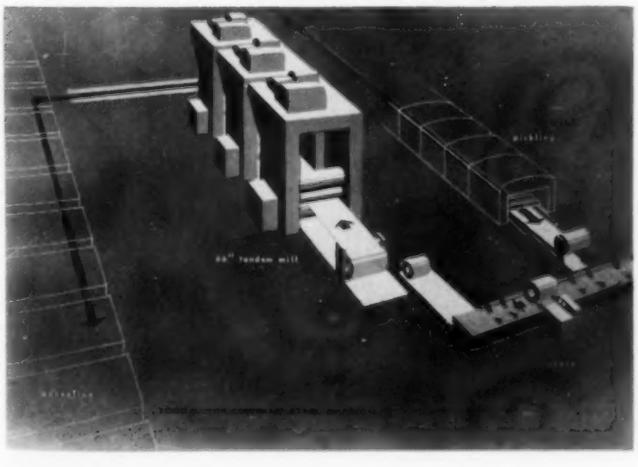
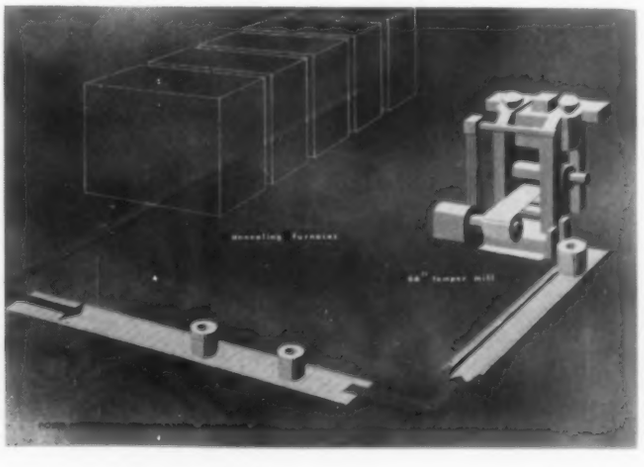


Figure 5 — From the annealing furnaces, coils go through the 66-in. temper mill and then to the finishing departments.



of this layout to the typical layout previously shown, illustrates the approach taken in the application of new designs in layout.

Figure 3 is a layout of conveyor system from the hot strip mill through hot coil storage and into pickle lines.

Figure 4 is a layout of conveyor from pickling through tandem mill into annealing.

In Figure 5 is shown a layout of conveyors from annealing to temper mill and finishing departments.

The efficiency of the open hearth was improved 10 per cent without adding additional furnaces. A 200-ton tilting furnace was converted to 400-ton stationary type. A new 275-ton hot metal crane was installed to handle the increased heat size. The charging floor was extended, two new charging machines were added, and the charging floor track layout redesigned to reduce charging delays.

Ingot stripping facilities were relocated to a new stripper building adjacent to the soaking pits. Ingot stripping in this location relieved present congestion and permitted spotting of entire heats directly in front of the new soaking pits. Heat loss and soaking pit charging time were reduced materially by this arrangement.

Existing soaking pits were replaced with more efficient pits with adequate capacity to eliminate a production bottleneck.

The blooming mill was altered to permit the rolling of 60-in. wide slabs from 65-in. ingots, and variable voltage control was installed on the main drive and auxiliary motors. The ability to roll slabs up to 60 in. wide eliminated cross rolling of short slabs on the hot strip mill.

The efficiency of the hot strip mill was improved by alterations to permit the rolling of heavier slabs and the production of heavier coils than was formerly possible. Coil size was increased 60 per cent overall and equipment was improved to handle a maximum of 16,000-lb coils.

These alterations included a new slab furnace and building to provide required heating and slab handling capacity, increased power of roughing mills, and the replacement of one two-high mill stand with a four-high mill, alterations to the coiler approach table and the replacement of existing coilers. A new conveyor capable of handling the heavier hot rolled coils to an inside storage area reduced handling and transportation to and from yard storage areas.

The improvements installed in the cold mill area incorporate the latest post-war developments in the steel industry, which permits the handling and processing of larger coils. The present coiling mechanisms and handling facilities of the pickling lines, cold reduction, and finishing units were replaced with equipment to handle large coils. Facilities for handling 16,000-lb hot rolled coils and 50,000-lb cold rolled coils were installed. The speed of the three-stand cold reduction mill was increased from 744 to about 1500 fpm.

Cold rolled product was formerly annealed in high cost equipment at four widely separated locations. Modern facilities were installed in one location to provide adequate capacity, eliminating rehandling and improving the flow of product. A new 66-in. four-high 2800-fpm sheet temper mill was installed in a new building together with auxiliary finishing equipment.

Prior to the modernization program, the facility investment was approximately $100 per net ton of finish product. On completion of the program, the asset value has increased by about $22 per net ton. This compares to an estimated $350 per net ton for a comparable new plant.

The modernization program, substantially completed in 1953, has provided the auxiliary equipment necessary for efficient material handling and, we believe, for the type of product produced is comparable to modern installations in the industry.

HEATING FACILITIES

By WILLIAM A. DAILEY
Surface Combustion Co.
Toledo, Ohio

▲ THIS paper covers in more detail the heating phases of steel production and the material handling problems associated with them.

In present day steel mills producing sheets for deep drawing, there are three major reheating units. First, the soaking pits which take ingots either from the open hearth or from storage and heat and maintain them at proper temperature for rolling. Second, the slab heaters which take hot slabs directly from the blooming mill or cold slabs from storage and heat them to the proper temperature for rolling on the hot strip mill. Third, the annealing furnaces for stress relieving and recrystalizing the steel strip from the cold reduction mills.

The soaking pits and slab heaters are designed almost completely around the problems of material handling. In fact, a major function of soaking pits is to serve as a storage point in the material conveying system between the open hearth and the blooming mill. If this function were not important or necessary, the design of soaking pits would be vastly different from that now used.

A slab heater is a furnace built around a pusher type of skid conveyor. Theoretical combustion efficiency is sacrificed in order to attain simplicity and reliability in the conveying system. A slab heater normally is not designed for storage, it serves only to heat the slabs to the proper temperature for rolling in the hot strip mill. The rate of passage of slabs through the slab heaters may be varied over a wide range. However, there is no provision for storage of hot slabs ready for rolling. Consequently, the space required for installation of slab heaters is very much less than that required for soaking pits and their associated material handling facilities.

At the annealing furnaces for finished cold reduced product, the situation is somewhat different and this equipment is basically designed for its primary function of slow cooling, and secondarily from the standpoint of material handling. Material handling represents a major part of the cost of this operation, and consequently location and method of heat application, are dictated from the standpoint of material handling.

SOAKING PITS

In a steel plant such as that operated by the Ford Motor Co., the purpose of soaking pits is primarily to furnish a steady supply of ingots at the rate and sequence desired and at a uniform temperature ready for rolling. The input of ingots to soaking pits comes primarily from open hearth furnaces and normally the rate at which the ingots are supplied by the open hearth will not correspond to the rolling rate of the blooming mill. The open hearths tend to furnish a relatively steady supply over a long period of time since they are operated continuously and shutdowns for maintenance usually affect only one of ten or more units. The short time fluctuations in delivery of ingots from the open hearth, however, are very great and frequently from one to three hours can pass without delivery of a single ingot while in extreme cases enough ingots will be delivered in the period of one hour to furnish the rolling mill for the next eight hours.

It is also frequently desired to heat and roll ingots from outside storage or even from another open hearth plant or an electric furnace plant. The optimum procedure is to maintain a substantial supply of these ingots from outside sources close to the soaking pits so that in the event of delays in delivery of ingots from the open hearth, or if it is desired to quickly change the rolling schedule on the mill, the stored ingots can be charged into the soaking pits for heating immediately without waiting for transportation from some remote point. When ingots are delivered quickly from the open hearth and charged into the soaking pits in a short time, only two to three hours are required to even out the temperature sufficiently for rolling. However, if there is any delay in delivering the ingots from the open hearth to the soaking pits even though it may be only of the order of one or two hours above the normal, or if it is necessary to heat ingots from cold, periods of time ranging from five to as much as 12 hours are required in the soaking pits to bring the ingots to the proper temperature and uniformity for rolling.

In addition to the uneven rate of delivery of ingots to the soaking pits, there are variations in the rate at which ingots are rolled. Normally a blooming mill operates at a relatively steady rate while it is in operation. However, the modern blooming mill with its accessories is extremely complex mechanically and practically there are usually delays in each eight hours of operation so that the mill may operate at a high and steady rate for three hours, and it may then shut down for as much as 30 minutes or possibly one hour due to mechanical problems in the mill or in the auxiliary equipment associated with it such as shears, scarfing machines, conveyors, etc.

The design problems for modern soaking pits of this type are complicated when heating steels for deep drawing processes because it is the practice to heat these ingots and hold them at the highest possible temperature. Generally, both the production and quality of the product of the blooming mill is increased by having the ingots at the higher temperatures. This temperature is limited at the present time by the melting point of scale on the ingots. Theoretically, in an atmosphere containing only oxygen and nitrogen, this scale should melt at about 2460 F. Practically, because of the presence of impurities such as sulphur in the fuel gas used to fire the soaking pits, the melting point of the scale may be a little lower. It follows from this condition that extremely precise control of the temperature should be maintained.

The attainment of satisfactory operation for all three of these design factors; that is, holding of hot steel ready for rolling without damage either by excessive scaling or by penetration of the thin skin on the top of the ingots; heating cold steel as rapidly as possible to rolling temperature; and, maintaining very precise peak temperatures to enable the highest possible rolling temperatures without actually melting the scale, requires extensive use of automatic control devices.

In fact, when soaking pits are designed to meet these conditions, it is actually impossible to operate them manually and still maintain satisfactory rolling performance. The fuel input is so high that if the pits were to operate at maximum input for just a few hours uncontrolled, they would be destroyed. Yet this maximum fuel input must come on automatically and instantly when drawing ingots. As ingots become larger and the size of the open hearth heat increase, the optimum size of soaking pits also increases. Each soaking pit is opened from six to 14 times or more during the drawing operation and enormous quantities of heat are lost each time it is opened. It is customary to supply sufficient fuel input and to have automatic control devices sufficiently fast so that the heat loss by opening a cover to remove an ingot may be regained during the short interval of time remaining before drawing the next ingot. Unless this can be done, the ingots progressively become cooler as the pits are drawn and the last ingot will be as much as 50 to 100 degrees colder than the first one with a resultant lower rolling rate and steel quality.

The above problems have resulted in the development of automatic control devices of a very high order. For example, in an installation such as that at Ford, the automatic temperature control devices may regulate the soaking pits at 2440 F which is within 20 F of the melting point of the scale. An error which would elevate the steel temperature above this melting point would result in very rapid oxidation and actual erosion of the steel. At the same time this automatic control equipment must repeatedly turn the fuel off or on, changing the heat input from 0 to 25,000,000 Btu per hour in about three seconds.

From the foregoing analysis, it may be readily seen that two important considerations in design and operation of soaking pit handling facilities are: rapid delivery of ingots from the open hearth to the soaking pit, and rapid delivery of ingots from the soaking pit to the rolling mill. Any delay in stripping the molds from the ingots and delivery of the ingots into the soaking pit results in decreased availability of hot steel ready for rolling and any delay (even of seconds) in delivering the ingots from the soaking pit where it is at the highest practical temperature to the rolling mill, results in a reduced rolling rate and lower quality of the resultant product. To achieve the first object (that

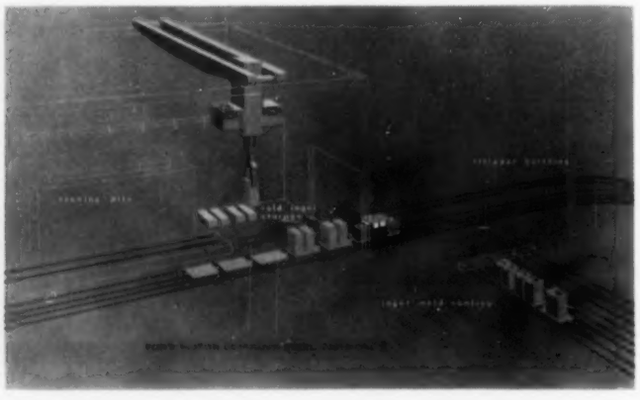
is, quick and orderly delivery of the ingots from the open hearth to the soaking pits), the space underneath the cranes which deliver ingots to and from the soaking pits should contain at least three standard gage tracks; one for delivery of operating and maintenance material and supplies, and two for delivery of ingots.

There should be space so that the ingot cars containing at least two entire heats may be delivered to the soaking pit building at any time with no interference in either delivery or removal of the ingot cars. See Figure 1. The soaking pits should be so located with respect to the tracks and overhead cranes that ingots may be charged into them, and also simultaneously delivered to the rolling mill without interference. There must be space adjacent to the soaking pits and under the cranes so that ingots may be picked out of individual soaking pits and placed on a car for rapid delivery to the mill conveyor table. This car must be able to travel to a point adjacent to any of the soaking pits so that the crane can take an ingot out of the pit and place it directly on the car, thus allowing the other cranes in the building to operate without interference.

The total travel of this ingot car should be as short as possible (Figure 2) to minimize the delay between the soaking pits and the mill table. All pits and cranes and also the rolling mill should be visible to the operator of the ingot car. In addition to these requirements, there should be ample space for storage of several thousand tons of cold ingots so that these ingots may be charged in soaking pits immediately when any delay in delivery of the hot steel opens up available heating space for them.

The recent improvement program at the Ford Motor Co. practically attained the ideal installation of soaking pit transportation systems and soaking pit layout. First, the necessary tracks and a new high speed ingot car are installed. These tracks occupy the major portion of the space under the ingot crane. At the end of the building closest to the mill, the remainder of the space under the ingot crane is filled solidly with active soaking pit area. It was possible to install 20 modern soaking pits each 8 ft wide by 25 ft long in this space. In addition, it was possible to open up space under the soaking pit crane and at the end of the building away from the mill for storage of about 8000 tons of cold ingots ready for heating. As a result, this installation represents a practically ideal condition equal to any

Figure 1 — Three sets of tracks should serve the soaking pit building.



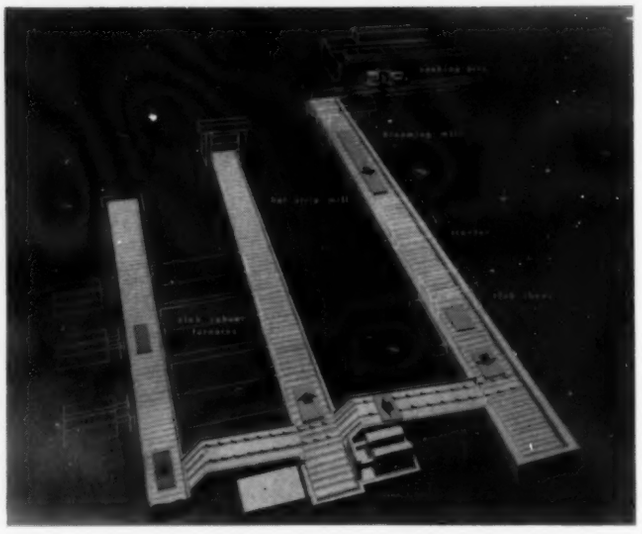


Figure 2 — Travel of ingot car should be kept as short as possible to keep cooling of ingot to a minimum.

that could be achieved in a new operation where there would be no restrictions to building size or track layout.

SLAB HEATING FURNACES

The modernization of the hot strip mill and of auxiliaries has resulted in increased slab heating requirements. Over the past five years the original five small slab heaters have been replaced by three large slab heaters of modern type each with a capacity of over 100 tons per hour. All of these slab heaters are so constructed that if it should become necessary, further increase in capacity may be obtained by modification of the combustion system. Slabs are delivered to the slab heaters either singly on a roller table or in packages of six or more by an overhead crane and are then pushed one by one by a mechanized conveyor system on water cooled skid rails through the heating furnace. From these skid rails they enter the hot strip mill through a roller table system. The slab heating furnace proper is a refractory structure and combustion system built around these skid rails. Since the water cooling of the skid rails causes those portions of the slabs immediately in contact with them to be cooler than the remainder of the slab, the last 20 per cent of the furnace length uses solid alloy rails embedded in refractory as a substitute for the water cooled skids. This allows the temperature to even out so that the cold spots or skid marks substantially disappear before the slabs are discharged from the furnace onto the roller table which conveys them into the hot strip mill. In addition, in the Ford Motor Co. slab heaters, the water cooled rails are covered with the most modern type of insulating material which reduces the heat loss to a fraction of that for uninsulated rails.

The slab heaters are equipped with sufficient automatic control devices to enable them to operate at varying rates in order to keep pace with the operation of the hot strip mill. They may be supplied with slabs which are already hot so that they only have to be heated from 300 to 400 degrees additionally to make them ready for rolling, or they may have to operate with cold steel from storage which has to be heated

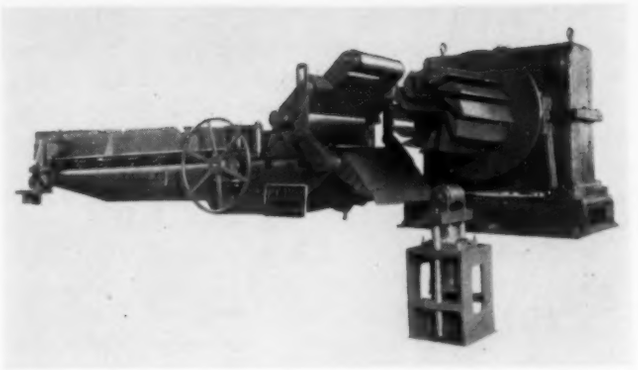


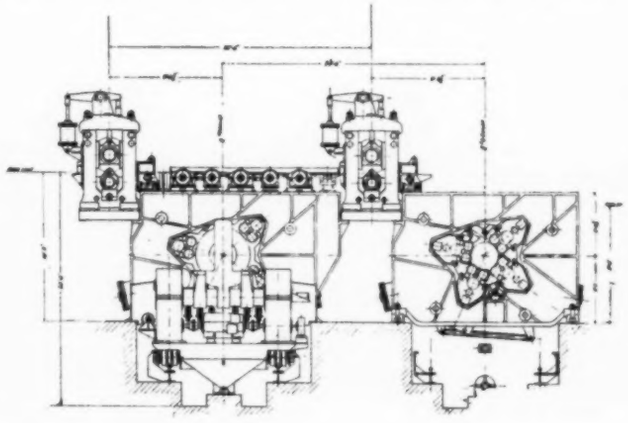
Figure 1 — The paddle wheel type coiler was one of the earlier ones developed.

about 2400 F before it can be rolled. The automatic control devices must operate satisfactorily over this wide range of heat requirement and must at the same time protect the furnace structure. Each slab heater has a maximum input of approximately 175,000,000 Btu per hour, and as is the case with soaking pits, each slab heater could destroy itself very rapidly if uncontrolled. Since the slab heaters are tied directly to the operating rate of the hot strip mill which is an extremely expensive machine, the utmost attention is paid in design to maintaining continuity of operation.

ANNEALING FURNACES

The installation of mechanized handling equipment for the cold reduced coils necessitated a completely new coil annealing department. After consideration of all the factors involved such as slab sizes, speed control problems on the rolling mills and minimum damage to the outer wraps of the coils, it was decided that 66 in. outside diameter by 24 in. inside diameter represented the most economical coil size. None of the existing annealing equipment was satisfactory for this size, and it was therefore completely replaced. The ideal annealing department of this type has been installed and consists of a row of batch annealing furnaces along one side of the building under a traveling crane with ample stocking space for coils to be annealed and for coils whose annealing is completed under the same crane runway and opposite the annealing furnaces. Thus the most practical way to charge and discharge coils from the

Figure 3 — Section through 66-in. mandrel type coiler.



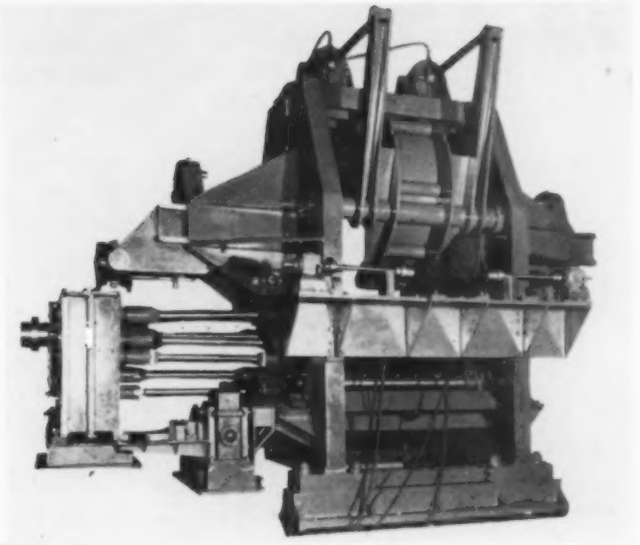


Figure 2 — The three-roll upcoiler was a later development.

annealing bases underneath the portable annealing furnaces is provided by means of overhead cranes with mechanical tongs for picking up the coils. Conveyors have been provided at floor level to move the coils of steel to and from this stocking space opposite the furnaces thus minimizing crane travel and allowing several cranes to operate without interference.

MILL EQUIPMENT

By GEORGE PERRAULT, JR.
Division Manager
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▲ OF all the metal products which were subjected to revolutionary progress, steel stands out. In this general class of steel products, the greatest progress has been made in the sub-classification of flat-rolled products, and the so-called packaging and handling thereof has, of necessity, been improved and refined to a point where from a competitive viewpoint it is almost essen-

Figure 4 — Mandrel type coiler shown is installed at Ford Motor Co.'s Steel Division.

tial for all producers to provide modern flat-rolled products handling equipment to cope with large orders of coils, bundles, etc., and yet preserve high-grade quality in the product.

This progress includes improved methods in handling steel strip which we shall attempt to cover especially at this time. The first problem encountered in the production of steel strip is at the hot strip mill; after the product has been rolled with exacting care to insure uniform gage, surface, and edge quality. With the advent of larger ingots, resulting in larger slabs, the final bar length has increased steadily until today we have to cope with strips; for example of 48 in. width, by 0.095 in. gage, measuring in length up to 1300 ft, from a 20,000-lb slab, and consequently making a long coil to handle.

For the coiling at this stage of production, various types of machines have been tried, and some quite successfully utilized, mostly coilers of one type or another.

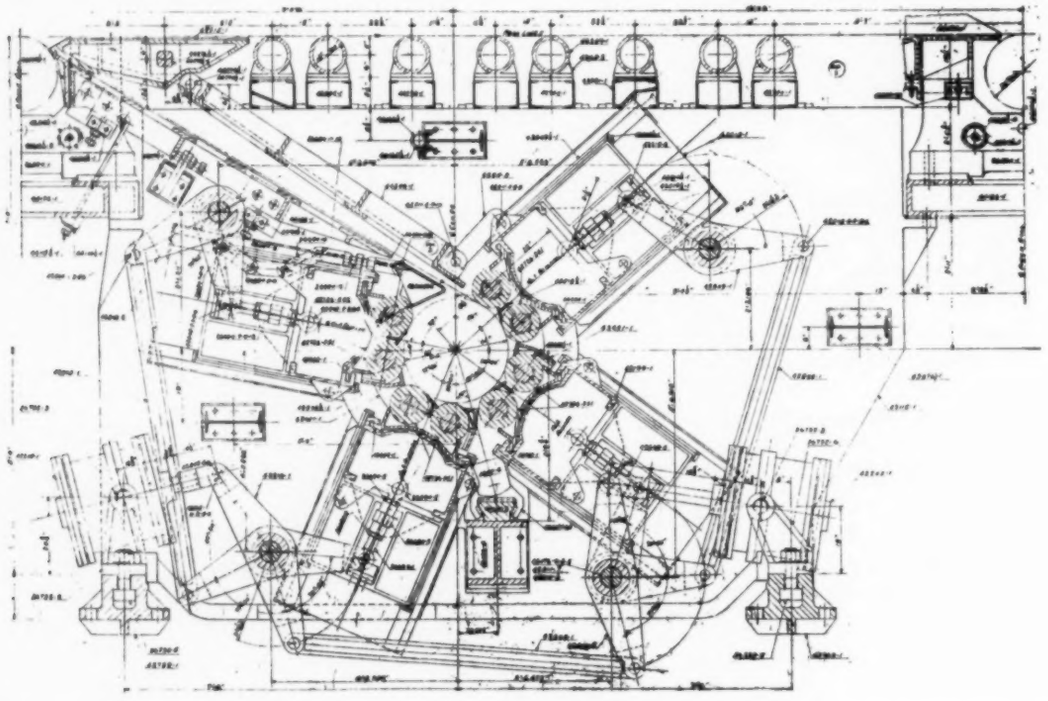


Figure 5 — Guide throat fits down close to the mandrel.

Of the various types utilized, the primitive paddle wheel, shown in Figure 1 and a three roll upcoiler is shown in Figure 2.

One of the outstanding units produced and utilized successfully to date is the driven mandrel type coiler with driven blocker rolls, similar to two units which have operated successfully now for over a year at Ford's Steel Division plant, among many others. These units are typically as shown in Figures 3 and 4.

In this arrangement, the prime unit, or mandrel, is harnessed to a 200-hp, 575/1150 rpm motor through a gear reduction unit for a maximum linear speed some 10 per cent higher than the maximum delivery speed of the last stand of the finishing train; in this case, approximately 2050 fpm. The high power, combined with mandrel strength and resistance to deflection, makes for maintenance of continuous, heavy tension on the strip being pulled over the runout table, and coiled up. This is essential to good strip guiding and coil build-up of regular, uniform edge without telescoped layers. It goes without saying that before strip is sufficiently wrapped to give good snubbing, or anchorage, around the mandrel, it must be squarely and properly guided into the entry guides, sloping and feeding downward, or upward, as the case may be in either downcoilers or upcoilers, which lead right up to the mandrel at a close tangential point. This close feed clearance of the guide is maintained only momentarily, until sufficient wraps have been made, following which the guide automatically retracts, on an interlocked movement with the blocker rolls, which complement the guide, on original wrapping function.

Figure 5 shows the guide throat feeding down close to the mandrel. As the strip comes traveling down the runout table, the entry guides of the quick air-actuated type, with motorized primary setting adjustment, as shown in Figure 6 directs the strip squarely and medially to the entry pinch rolls, of which the bottom roll is smaller in diameter to form the sharp radius and set the course of the strip downward into the final guide. In case of upcoiler, the top roll is the smaller to guide and set course of strip upward. Through the pinch rolls, the strip is moved at a speed synchronous with runout table speed, but the mandrel and blocker roll speeds are such that tension always exists, through the complete bar length, between mandrel and pinch roll, again insuring good guidance.

The blocker rolls function to block the original wraps, and again on the final wraps, as they are actuated in and out in four pairs, each pair driven from a 30-hp motor in this case. Incidentally, all motors are d-c, variable voltage motors, to afford minute synchronizing of speeds. These sets of rolls are located clockwise in 1:30, 4, 7, and 9:30 o'clock positions.

Once the coiling of the bar is completed, the mandrel is collapsed to a reduced diameter, to facilitate stripping of the coil, via an air-actuated stripper plate, onto

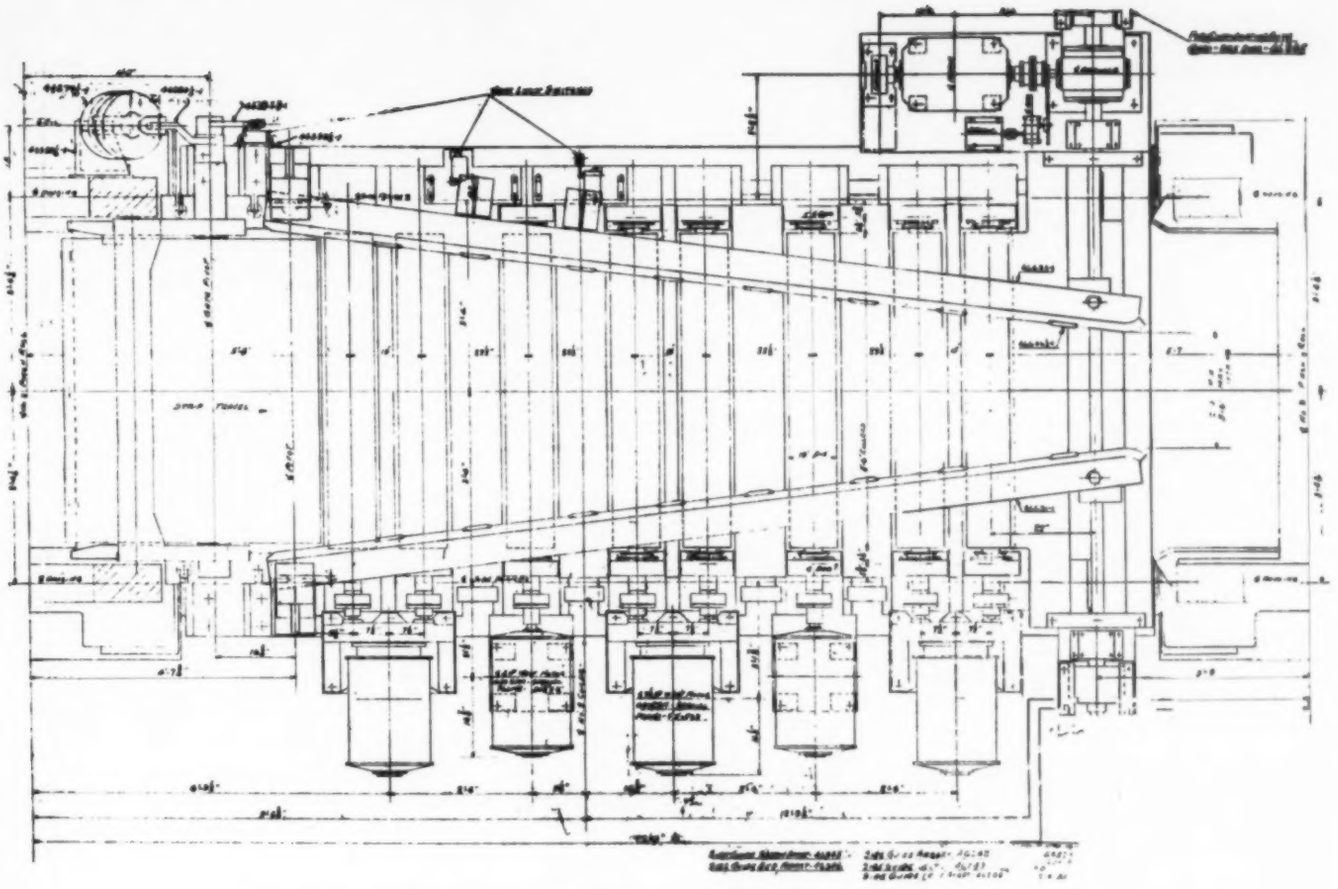


Figure 6 — Air-actuated entry guides direct the strip to the entry pinch rolls.

the receiving coil downender, typically as shown in Figure 7. After receiving coil, it is downended, and regardless of size in outside diameter, the same is centered for smooth deposit on the center of the strand coil conveyor. This centering is done by means of a target pin which projects from the downended leg of the cradle, or angle, and pilots the coil-supporting slide outward to an automatically determined "homing point" for that particular outside diameter coil, with the inside diameter always the same, and since the "homing" pin is always piloted inside the core of the coil, the necessary sliding, or centering, travel is interpreted to compensate for coil outside diameter and its high or low cradled position in the receiving leg of the downender.

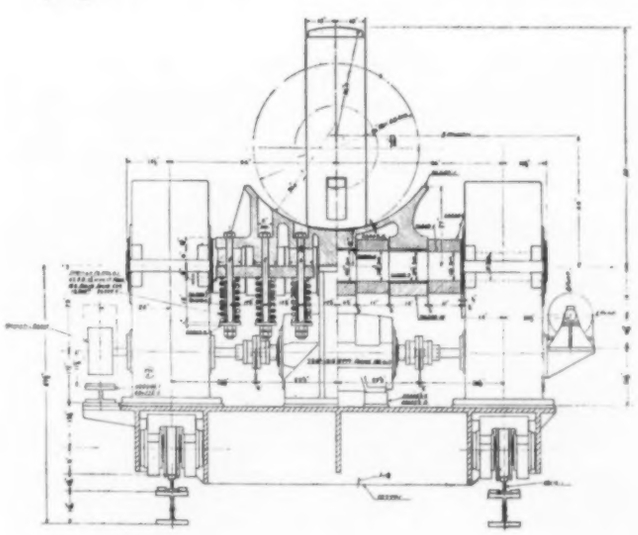
Stripping is facilitated by the full collapse afforded by the mandrel operating on sliding wedge principle, which actuates four segments of the block, as shown in Figure 8. Note that the segment and wedge arrangement is such that the pull-rod is in tension with mandrel in expanded position.

Once centered over the coil conveyor, by the traversing movement of the coil downender buggy, the waffle top shown in Figure 9 receives the coil in easy deposit fashion to preserve good coil formation, on the stools, in elevated position. Sliding member of automatic coil positioner is visible in this view. After this, the buggy and downender retract to allow for descent of the waffle top to an elevation below that of flat top strand coil conveyor, allowing again for smooth deposit of the coil to preserve its character and quality. From here, the coil is on its way to smooth, jar-free travel to the next processing station.

The coiler features many interlocks, such as:

1. No full speed of mandrel is possible unless same is fully expanded; thus barring centrifugal damage.
2. No stripping of coil unless blocker rolls are fully retracted.
3. No upending of downender on return stroke, until the downender leg is free of the waffle top.

Figure 7 — An air-actuated stripper plate facilitates stripping.



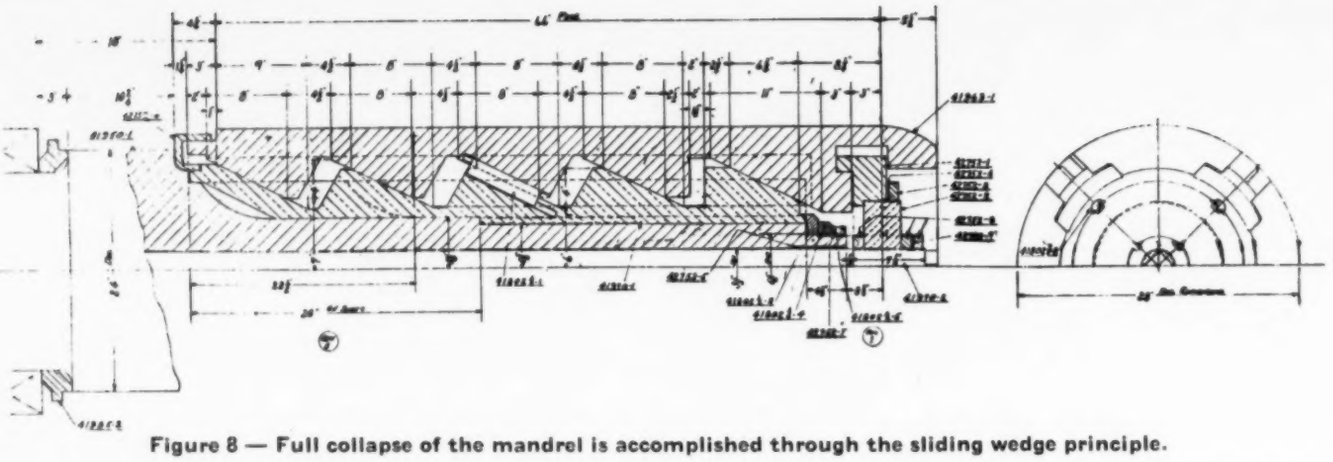


Figure 8 — Full collapse of the mandrel is accomplished through the sliding wedge principle.

4. Many others, including either hydraulic, air, or motorized actuations, depending upon such factors as length of downender travel, to conveyors, etc.

This type coiler has been designed so far for mandrel widths up to 96 in., and coil weights of 30,000 lb maximum. To date, it has enjoyed unique success in various plants, and in various arrangements to suit material flow and/or plant layout.

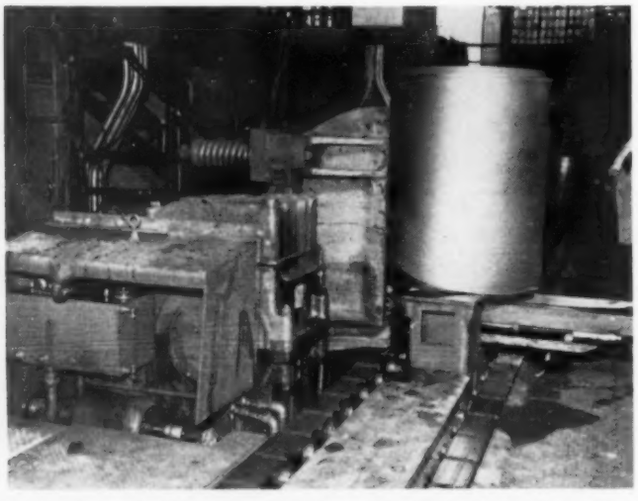


Figure 9 — It is necessary to deposit the coil gently to preserve good coil formation.

Among other modern improvements at Ford's steel plant has been the modernization of several mills as shown in Figure 10, plus addition of a new temper mill, each including special equipment for heavy coil handling in a manner which might be termed safe and delicate in handling these ponderous masses.

While on the subject of coil handling equipment in a modern arrangement around a mill, a typical arrangement is the Ford mill well presented in Figure 11. This particular mill is of course a one-way mill for temper passing. The entry equipment for this 19 and 53 in. x 66 in. mill consists of a flat top entry conveyor for transporting coils on edge to a station, or junction, where they are upended onto a set of coil positioning and preparation rolls of the cradle type, whence the coil is traversed and core-threaded onto the payoff mandrel, designed to handle coils up to 1000 lb per inch of width; said mandrel being 24 in. in diameter. This arrangement allows for preparation and positioning of a subsequent coil, while the one is being rolled into the mill, thereby saving encroachment of handling time into the available rolling time.

For large coil handling, support and high-speed rotation in coiling or uncoiling, we use a reel, as shown typically in Figure 12. The block itself is made up of inner and outer wedges, segments, and push-rod for expanding and collapsing the block.

Figure 10 — A number of mills were modernized at the Ford plant.

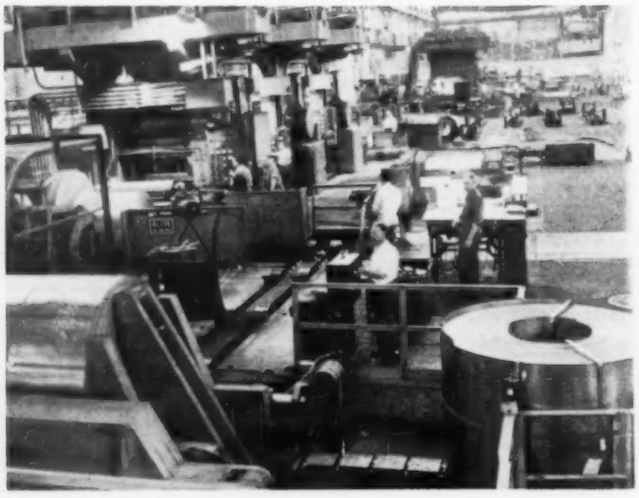
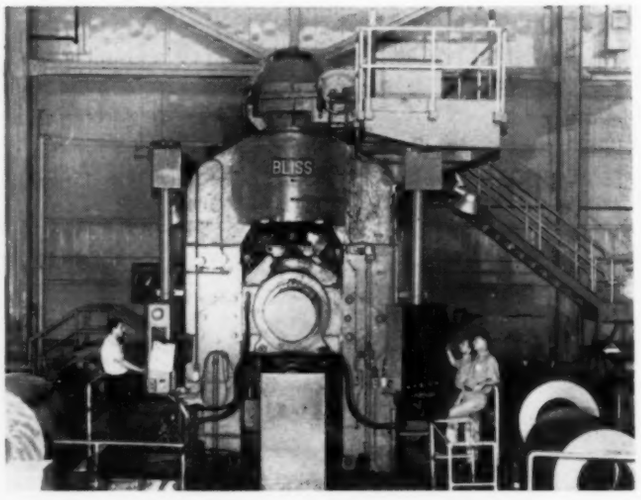


Figure 11 — This 19-in. and 53-in. x 66-in. mill is used for temper passing.



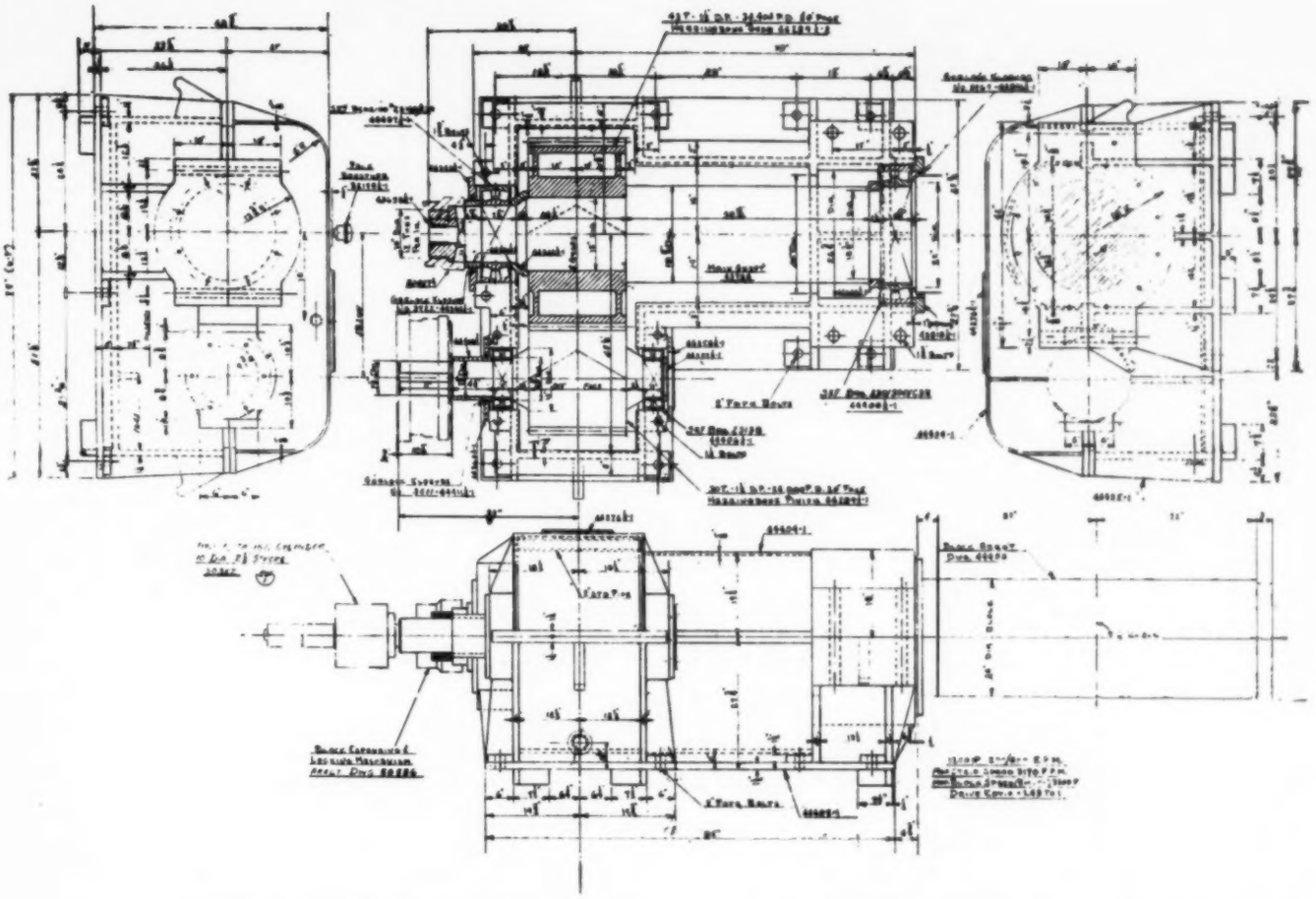


Figure 12 — Reel design shown is used for large coils and high speed rotation.

1. Actuation is either by air or hydraulic pressure, depending upon application.
2. Some are equipped with locking pins, as in the case of air-actuation to insure maintained full expansion with a coil.

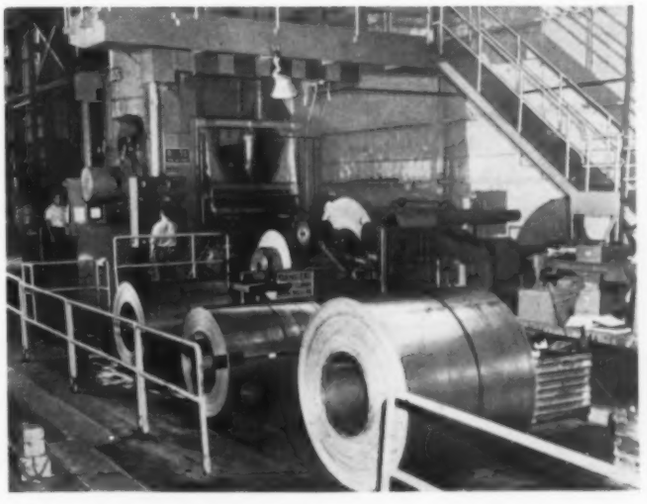
The delivery end as shown in Figure 13 likewise is equipped with a 24-in. diameter block tension reel and coil buggy for handling the same large coils which are eventually transferred to a power-driven conveyor, again effecting heavy coil transport which is protective to the coil and the personnel, because every motion or movement is controlled.

We previously referred to the Ford modernization of their three-stand tandem cold reduction mill. This unit in its new arrangement is a 66 in. mill with new terminal equipment. These new auxiliaries designed for heavy coils permit the positioning and preparation of coils to be fed, and include new fast-transfer conveyors, all of which add up again to improved efficiency and safety of the line, far beyond what could ever be imagined even as recently as the time of planning this improvement.

Equipment of this type naturally pays for itself, besides being almost compulsory in heavy coil handling, because the unavoidable coil opening, square trimming, and rebanding work can be done while the mill is working affording optimum mill operating time. It is our feeling that where larger coils are possible, it is often better to concentrate on improved material or coil handling than to spend money on power for speeding up a mill. There are, however, instances where the latter is indeed justified towards increasing production; the sum of both is better, but material handling improvements are major.

It is our feeling that if all specialty designers and manufacturers continue in their efforts to team up with steel plant management towards providing equipment that will spell improved efficiency plus safety for the personnel, we shall all some day benefit more from our efforts.

Figure 13 — Delivery end has 24-in. diameter block tension reel and coil buggy.



An Agglomeration Process for Iron Ore Concentrates

By W. F. STOWASSER, Allis-Chalmers Manufacturing Co., Milwaukee, Wis.

. . . . pilot plant operations have demonstrated the successful agglomeration of iron ore . . . . process is economical due to sensible heat recovery . . . . space requirements are reasonable . . . .

▲ THIS paper describes a pilot plant built to convert iron ore concentrates into a form which can be easily transported and smelted in blast furnaces. The process developed in the pilot plant at Carrollville, Wisc. consists of balling the concentrates and burning these balls on a continuous horizontal grate.

DESCRIPTION OF PROCESS

The first step in the process incorporates the art of balling, and in this form the concentrates are prepared for burning. The second part of the process consists of burning the green balls on the grate machine to the hardness required for shipping and handling purposes and for reduction in blast furnaces.

Facilities are provided at the pilot plant to receive carload quantities of concentrate. The concentrates are loaded into a 50-ton bin directly from the railroad car. Because of the variable moisture content present in the concentrates after shipment in an open railroad car, it is necessary to repulp and refilter the concentrates to maintain a uniform and proper moisture content for the balling operation of the process.

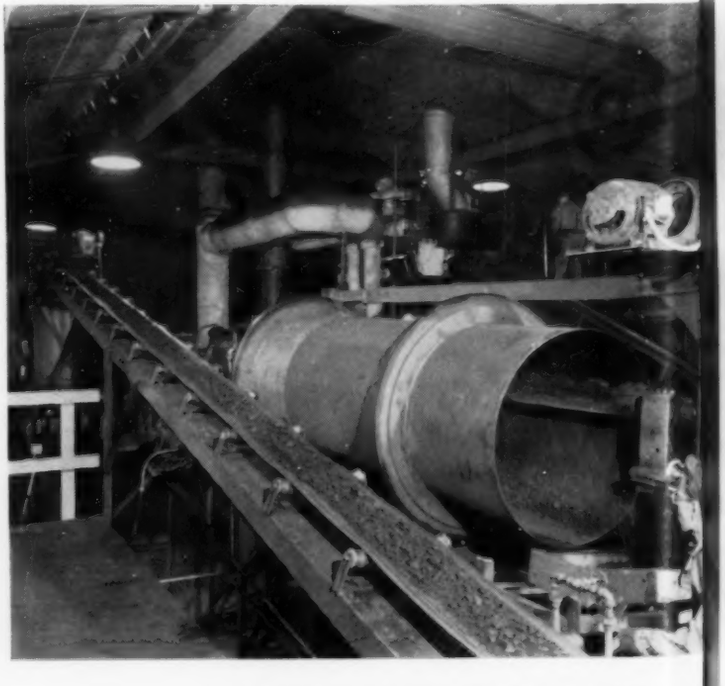
Concentrates are conveyed to slurry tanks, and the slurry, containing from 50 to 65 per cent solids, is pumped to a 4-ft diameter by 4-ft wide drum filter. The filter provides feed of uniform moisture to the plant. Magnetite concentrates are normally filtered to produce a cake containing about 10 per cent moisture, which is a necessary requirement for the following balling operation.

The filtered concentrate is conveyed to a rotary bin table feeder which acts as a surge bin for the filter cake and feeds a uniform flow of concentrates to the balling drum.

It is often desirable to make additions to the concentrates as they are fed to the balling drum. These additives, such as bentonite, are used to improve the strength of the finished green pellet and to improve the ballability of the concentrate. A vibrating feeder is used to feed the additive onto the feed belt, and it is mixed with the concentrate in the balling drum.

The balling drum is shown in Figure 1. This drum is 8 ft long and 3 ft in diameter. An oscillating cutting bar maintains the lining in the drum by trimming off

Figure 1 — In balling drum operation, filtered concentrates on conveyor in foreground are discharged onto table feeder.



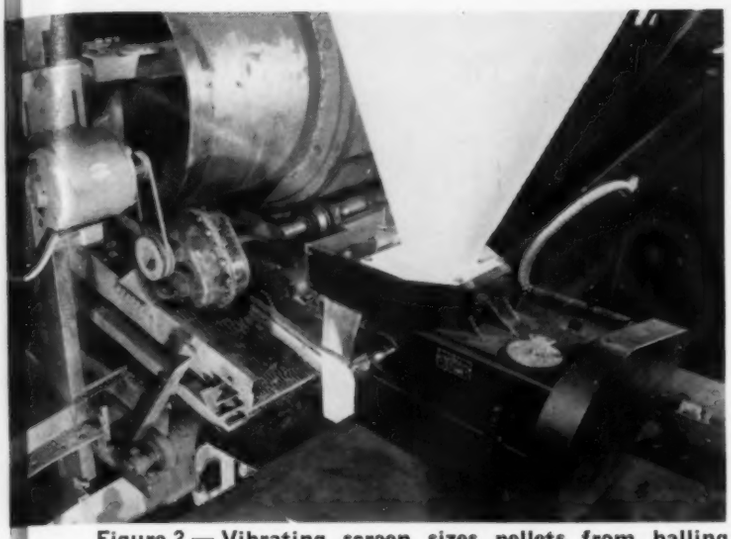


Figure 2 — Vibrating screen sizes pellets from balling drum. Coal feeder in foreground adds fine coal to sized pellet conveyor.

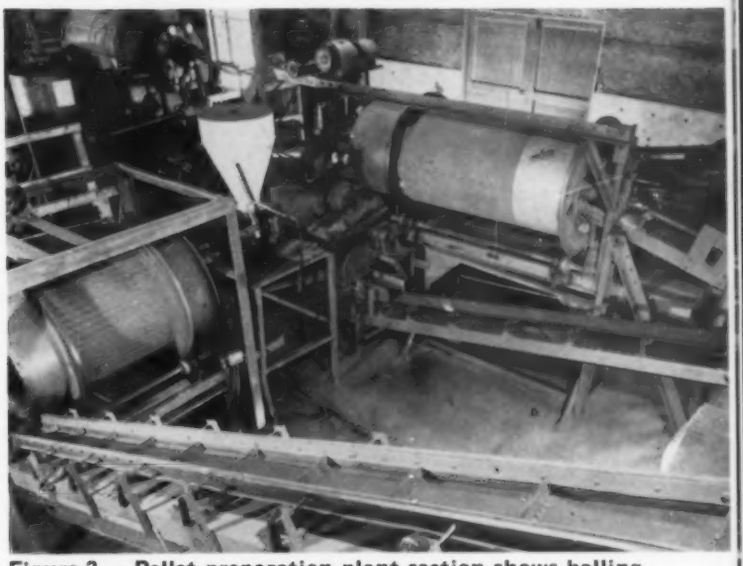


Figure 3 — Pellet preparation plant section shows balling and coal reroll drum circuit.

the buildup of excess concentrate as it forms. The drum is operated in closed circuit with a 1-ft wide by 4-ft long rod deck vibrating screen. The undersize pellets or seed pellets from the screen are returned to the balling drum until they grow to the desired size.

The size of pellets is controlled by the opening in the screen deck. The formation of pellets in the balling drum is affected by many variables. Some of these are: the size distribution of the feed, the particle shape of the concentrate, the feed rate to the drum, the moisture in the concentrate, the speed of rotation of the drum, the slope of the drum, and the type of trimming obtained with the cutting bar. In this process, attempts are made to control the pellet size within the limits of $\frac{3}{8}$ to $\frac{5}{8}$ in. in diameter.

The screened oversize pellets are conveyed under a coal feeder where sufficient powdered coal is added to the belt to produce the desired results in the burning process. The top size of the coal successfully used has been 20 mesh. Anthracite coal was used in the test program. Figure 2 illustrates the vibrating screen and the coal feeder. The pellets and free coal are conveyed together to the coal reroll drum. The purpose of this drum is to roll the coal onto the surface of the pellets. It is 3 ft in diameter and 5 ft long and is equipped with a cutting bar. Figure 3 shows the relationship of the filter, balling drum, sizing screen, coal feeder, and coal reroll drum in the plant.

The prepared pellets, containing bentonite, water, and surface coal, are elevated to the traveling grate. The grate consists of a continuous strand of 37 pallets. The individual pallets have a grate bar area 2 ft wide by $1\frac{1}{2}$ ft long, with 14-in. high side plates. The return strand of pallets passing over the grate drive sprocket is shown in Figure 4.

The method used to feed and distribute the green balls to the grate is shown in Figure 5. The balls are transferred to a short conveyor which oscillates back and forth across the 2-ft width of the grate. An adjustable vertical plate, not shown, located several inches in front of the head pulley of the oscillating conveyor, controls the height of the bed and levels the moving bed of pellets. This method of feeding prevents segregation of various size pellets as well as fines, and produces a uniform, permeable bed.

The pallet train moves under the furnace and across four windboxes, located beneath the pallet frames. The relationship between the furnace position with respect to the location of the partition walls separating the windboxes is evident from the following description and Figure 6.

As the pellets are deposited on the grate, partial

Figure 4 — On drive end of traveling grate, conveyor elevates pellets from coal reroll drum to grate.

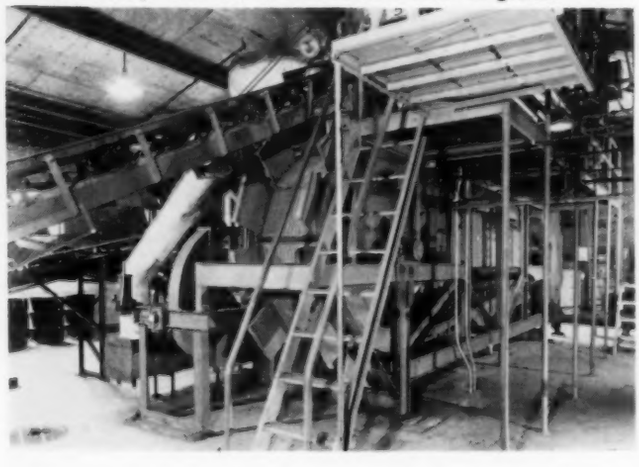


Figure 5 — Oscillating conveyor pellet feeder discharges pellets onto traveling grate.

drying of the pellets is started. A 2-ft long updraft windbox below the grate is used to remove part of the moisture in the bed. The low temperature air reduces the moisture in the pellets in the lower level of the bed and is essential to prevent sagging of the bed during latter stages of the process. The air used for this drying is recuperated from cooling the pellets on the grate, and supplemental heat, required for starting the process, is obtained from an auxiliary burner.

The final stage in the process is cooling the pellets over the cooling windbox. This windbox is about 3 ft long, and its purpose is to extract the remaining sensible heat from the bed of pellets. This heat is recirculated for updraft drying purposes.

Figure 8 shows the fan arrangement for each of the windboxes, and the ductwork for recuperating the sensible heat from the burning process.

The burned pellets are discharged over a grizzly

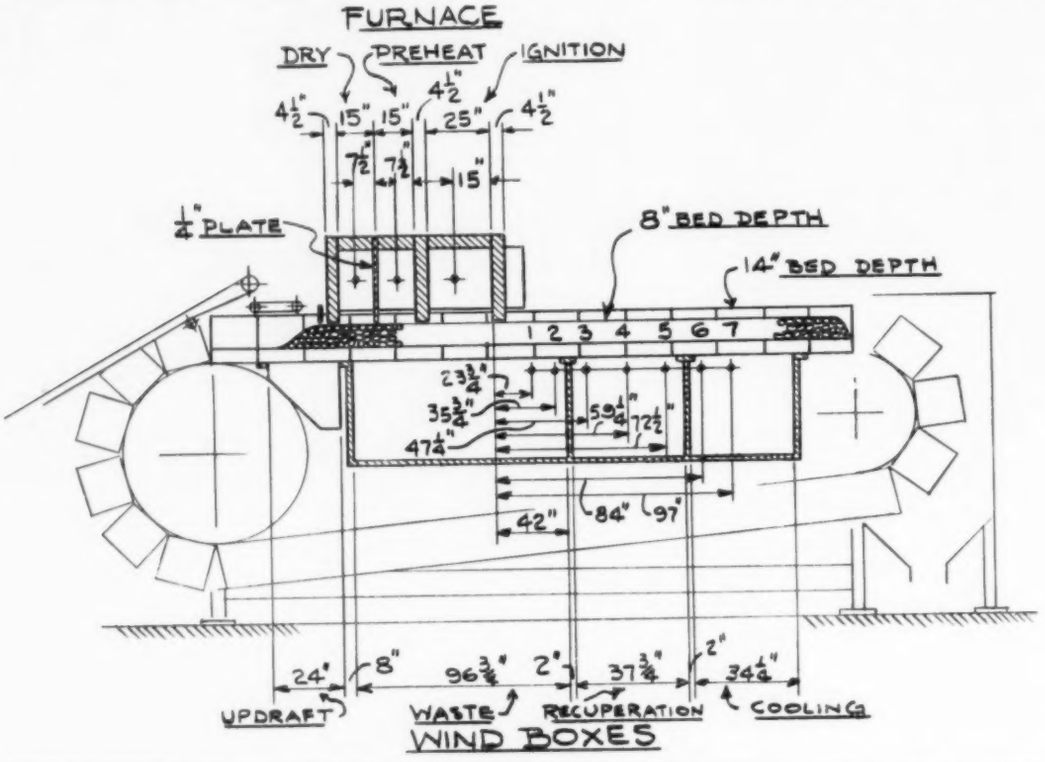


Figure 6—Sketch of traveling grate shows wind box locations.

The pellets are moved by the grate into the furnace and over an 8-ft long windbox, designated as the downdraft waste windbox. The products of combustion are exhausted from this windbox to atmosphere.

The furnace is shown in Figure 7. It is constructed with three chambers to provide downdraft drying, preheating and ignition, respectively, to the pellet bed as it passes through. The overall length of the furnace is 5.75 ft; however, the exterior wall ends may be moved to reduce the length and also adjusted to obtain the bed height desired.

The drying, preheating and ignition sections of the furnace are supplied with medium temperature air recuperated from the windbox following the waste windbox, designated as the recuperation windbox. These furnace sections are equipped with burners to raise the temperature of the recuperated air to that required by the process.

The bed of pellets passing through the furnace is dried, preheated, and the surface layer of pellets ignited by downdraft gas flow. Burning progresses through the bed of pellets to the grate bars. The pellets below the high temperature zone in the bed are preheated and dried while those above are cooled. The "burn through" occurs over the recuperation windbox, approximately 3 ft in length.

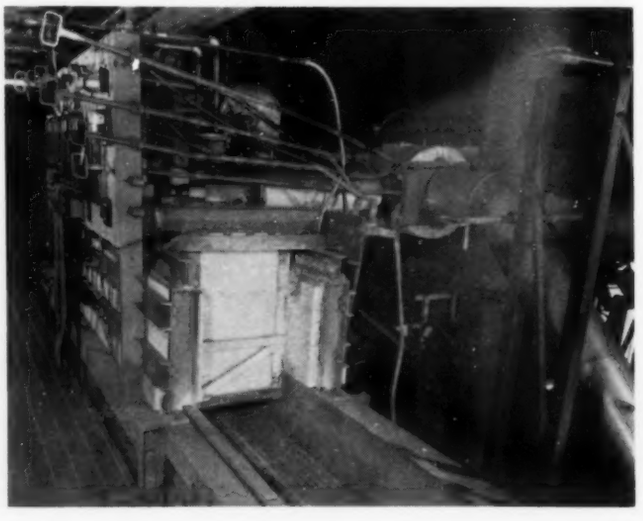
The gas temperatures from the grate are a maximum at the point of "burn through," and this gas is recirculated to the furnace for the purposes described.

deck at the end of the machine. They are conveyed to a screen tower, Figure 9, outside of the building, where a separation is made over a ¼-in. and 8-mesh screen.

OPERATIONAL RESULTS

The product obtained from the grate is shown in Figure 10. A pallet is about to discharge the product which averages from 90 to 96 per cent plus ⅜ in. in size. The strength of the product is determined by

Figure 7 — Traveling grate furnace has three chambers.



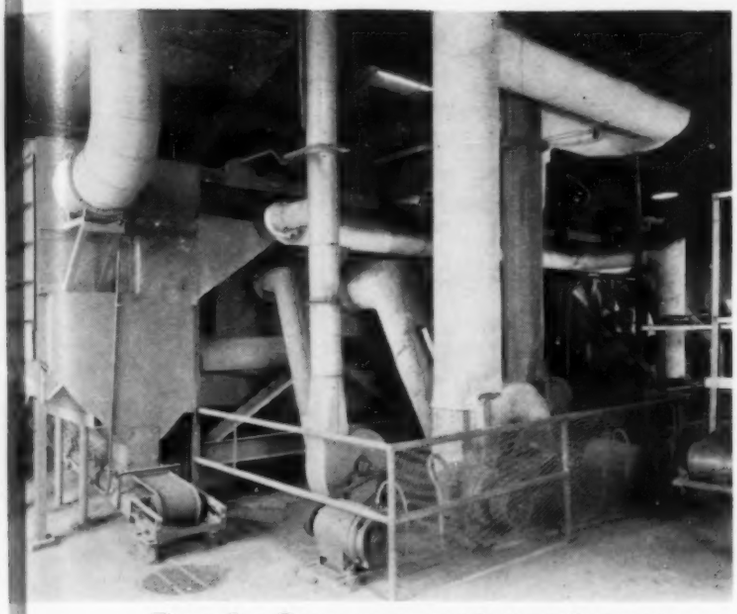


Figure 8 — Fan arrangement for traveling grate.

revolving a 50-lb sample of plus ⅜-in. pellets in a standard ASTM coke drum at 24 rpm for 100 revolutions. The per cent minus 10 mesh of the screened product after tumbling averages about 10 per cent.

The fuel requirement for burning magnetic pelletized concentrates varies from 700,000 to 800,000 Btu per long ton of product. Approximately one-third of the fuel is consumed in the burners, where propane gas is used, and two-thirds of the fuel is solid fuel in the bed of pellets.

The capacity of the grate is about three long tons per hour with an average grate speed of 4 to 6 in. per minute, depending upon the bed height.

The suctions in the waste, recuperation, and cooling windboxes range approximately from 3 to 4, 3 to 5, and from 2.5 to 3 in. water gage, respectively, and the pressure in the updraft windbox is about 3.5 to 4 in. water gage.

The temperature of the recuperated air from the recuperation and cooling windboxes ranges from 600 to 800 F and 300 to 400 F, respectively, depending upon the operation. The ignition temperature is maintained at 2300 to 2400 F. The temperature of the waste gas from the waste windbox ranges from 200 to 275 F.

SUMMARY

The downdraft traveling grate process to agglomerate pelletized iron ore concentrates has been successfully demonstrated in the pilot plant phase of this development. The product obtained from these tests indicates the strength to be sufficient to withstand transportation and handling to the lower lake ports. The fuel consumption, as shown, results from the effective recuperation of the sensible heat from the process. The output per sq ft of grate area was about two long tons per 24 hours. This tonnage result is obtained for the process by including the grate areas which are utilized to recuperate the sensible heat from the product.

Figure 9 — Grate product pellets are conveyed to screen tower and stockpiling.

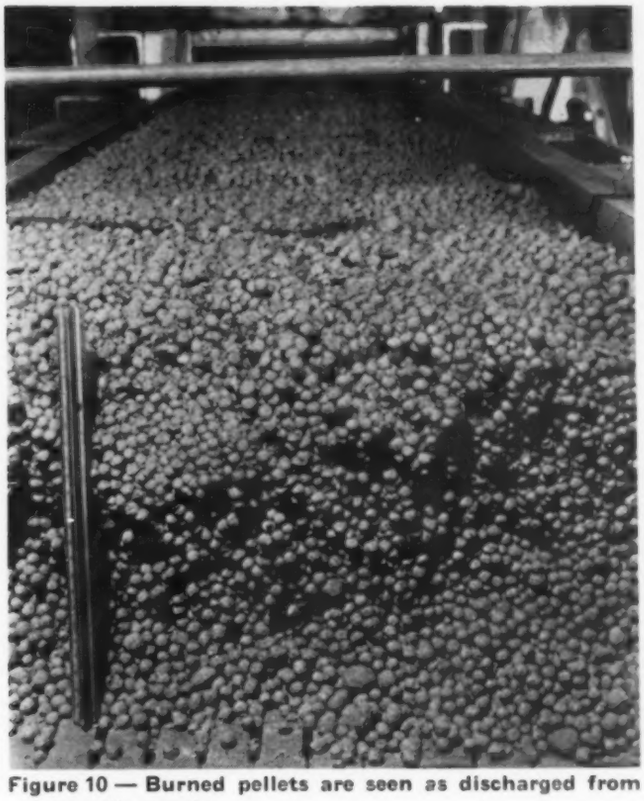


Figure 10 — Burned pellets are seen as discharged from traveling grate.

DISCUSSION

PRESENTED BY

WILLIAM H. COLLISON, Plant Superintendent, Blast Furnaces and Coke Works, Great Lakes Steel Corp., Ecorse, Detroit, Mich.

W. F. STOWASSER, Allis-Chalmers Manufacturing Co., Milwaukee, Wis.

William H. Collison: I would like to inquire about the physical characteristics of the balls, particularly hardness. Is the surface hardness greater than the interior?

W. F. Stowasser: The relative strength of a fired pellet depends on the size of the ball and on carbon distribution in the ball. Generally, a pellet larger than ⅜ in. in diameter, will have a relative strong shell and weaker core. A ball formed with admixed coal will develop a reducing state in the core, which results in slag bonding of the core. The surface will form a structure of cemented grains of recrystalized hematite from the magnetite and is a stronger structure than the slag bonded core. The relative depth of oxidation of the pellet is a function of the size of the pellet, temperature — time cycle, and carbon distribution in the pellet.

CURRENT AISE DISTRICT SECTION MEETING NOTICES

BIRMINGHAM SECTION

Monday, April 25, 1955 — Social Hour 6:30 P.M., Dinner 7:00 P.M., Meeting 8:00 P.M.

"Preventive Maintenance Insures Production," by H. L. Huntley, Sales Manager, Manufacturing and Repair Div., Westinghouse Electric Corp., Pittsburgh, Pa.

Thomas Jefferson Hotel, Birmingham, Ala.

BUFFALO SECTION

Tuesday, April 12, 1955 — Inspection Trip 2:30 to 5:30 P.M., Dinner 6:00 P.M., Meeting 7:30 P.M.

Inspection Trip to Dominion Foundries and Steel Co., Ltd.

"Oxygen Steelmaking Process," by F. J. McMulkin, Development and Research Engineer, Dominion Foundries and Steel Co., Ltd., Hamilton, Ontario, Canada

Veteran's Club, Hamilton, Ontario.

CHICAGO SECTION

Monday, April 4, 1955 — Dinner 6:15 P.M., Meeting 7:45 P.M.

"Application of Germanium Power Rectifiers and Transistors in Metal Rolling and Processing," by D. R. Cochran, Steel Mill Engineering Div., and M. W. Cannon, Industry Control Engineering Div., General Electric Co., Schenectady, N. Y.

Phil Smidt's Restaurant, 1205 N. Calumet Avenue, Hammond, Ind.

CLEVELAND SECTION

Tuesday, April 19, 1955 — Dinner 6:30 P.M., Meeting 8:00 P.M.

"Taconite," by F. M. Darner, Executive Supervisor of Engineering, Reserve Mining Co., Cleveland, Ohio

University Club, 3813 Euclid Avenue, Cleveland, Ohio

DETROIT SECTION

Tuesday, April 12, 1955 — Dinner 6:30 P.M., Meeting 8:00 P.M.

"Recent Developments in European Steel Practices," by H. B. Emerich, Assistant Director, Technical Services, Jones and Laughlin Steel Corp., Pittsburgh, Pa.

Main Ballroom, Dearborn Inn, Oakwood Boulevard, Dearborn, Mich.

LOS ANGELES SECTION

Monday, April 11, 1955 — Dinner 7:00 P.M., Meeting 8:00 P.M.

"History of the Fontana Blooming Mill," by Reynold MacDonald, Superintendent of 46-in. Blooming Mill and 29-in. Structural Mill, Kaiser Steel Co., Fontana, Calif.

Rio Hondo Country Club, Downey, Calif.

PHILADELPHIA SECTION

Saturday, April 2, 1955 — Dinner 6:00 P.M., Meeting 7:00 P.M.

"Roll Neck Bearing Design, Developments and Trends," by R. L. Humphreys, Lubricating Engineer, Mechanical Dept., Bethlehem Steel Co., Sparrows Point, Md.

"The Function of the Engineering Department in the Steel Plant," by F. C. Schoen, Chief Engineer, Alan Wood Steel Co., Conshohocken, Pa.

Engineers' Club, 1317 Spruce Street, Philadelphia, Pa.

PITTSBURGH SECTION

Monday, April 11, 1955 — Social Hour 6:00 P.M., Dinner 7:00 P.M., Meeting 8:00 P.M.

"Continuous Hot Dipped Galvanizing," by Nelson E. Cook, General Superintendent of Galvanizing and M. D. Ayers, Chief Engineer, Wheeling Steel Corp., Wheeling, W. Va.

Alumni Room, University Club, University Place, Pittsburgh, Pa.

ST. LOUIS SECTION

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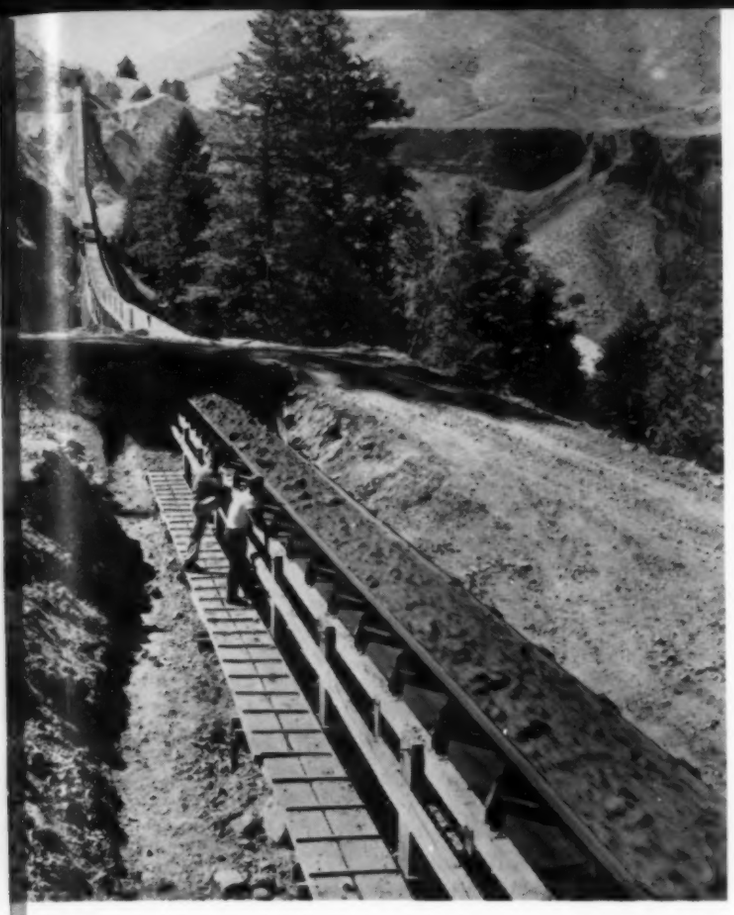
SAN FRANCISCO SECTION

No meeting scheduled.

YOUNGSTOWN SECTION

No meeting scheduled.



. . . . design of drives and control for conveyor systems requires detailed analysis under part and full load considering effect of belt stretch . . . . particular consideration must be given to effect of grades . . . . in multiple belt systems, operation of various units must be coordinated with each other . . . . in spite of all these factors, belt conveyors give very economical and dependable material transport . . . .

Choosing Electrical Equipment for Belt Conveyors

By W. J. HEACOCK
Electrical Engineer
Link-Belt Corp.
Chicago, Ill.

▲ THIS paper discusses the electrical problems associated with long belt conveyor lines for materials handling. The electrical problems involve the application of motors, controls, safety devices and distribution of power. Since the application of a motor is important only to the conveyor it drives, we will cover some of the problems involved in individual conveyors. In our discussion of controls we will cover the long conveyor systems.

MOTORS AND CONTROLS

There are several problems involving the matching of motor torque characteristics with the belt conveyor requirements. Among these are determining the maximum permissible tension the belt may be subjected to; keeping within the maximum T_1 to T_2, ratio; avoiding lifting the belt off the idlers in cases wherein there is a vertical curve in the belt, and, finally, considering the influence of the normal stretch of the belt.

Steady-state conditions offer no problems. It is for the starting conditions that care must be exercised.

Belt manufacturers usually specify that the maximum tension during acceleration should not exceed 40 per cent over rated tension. This does not mean that the motor must not have a torque rating in excess of 140 per cent. We often start, across the line, motors having 200 per cent torque, without exceeding the 140 per cent requirement. This is because the torque available for acceleration, which is that over the friction and gravitational requirements, is proportioned the same as the equivalent WK^2 of the (load, belt, pulleys and idlers) and the WK^2 of the (motor, reduction and drive pulley.) Usually the WK^2 of the motor is in excess of that of the load.

An example will illustrate why this is the case. Suppose the friction and gravity loads account for 100 per

cent of the rated torque of the motor leaving 100 per cent (out of 200 per cent) for acceleration. Assume it was determined the load contributes 30 per cent of the WK^2 and the motor 70 per cent. The belt is then loaded the 100 per cent plus 30 per cent or 130 per cent tension. This is well below the limit of 140 per cent. If other conditions are satisfactory, the motor may be started on full voltage.

In this particular conveyor, driven by a 75-hp motor, having a WK^2 of 68 lb-ft^2 the equivalent weights of

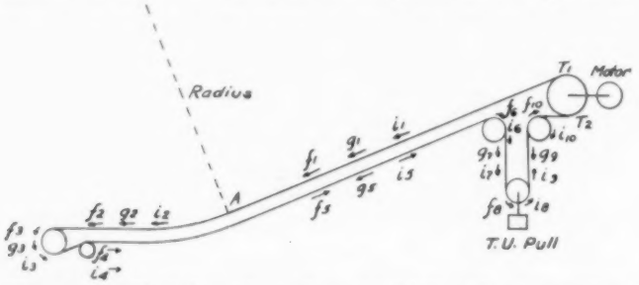


Figure 1 — Sketches show forces which act on conveyor belt.

the motor, drive and head pulley, at the belt line were 54,250 lb. The conveyor belt, load, idlers and pulleys had an equivalent weight of 17,350 lb. In this case the motor and drive accounted for about 76 per cent of the WK^2 of the system.

Maximum T_1 to T_2 ratios vary from 2.193 for 180-degree wrap bare pulley to 4.342 for 240-degree wrap rubber lagged pulley. These values allow a 50 per cent margin for acceleration. Calculations, as described later, will show whether the ratio is too great, thereby resulting in slippage.

In the case of a belt with a vertical curve wherein the radius of the curve had been established, it is necessary to determine whether the torque will cause the belt to be lifted off the idlers during starting.

All three of these conditions can be determined by one set of calculations outlined in Figure 1.

This figure illustrates a conveyor having a vertical curve. The letters "f_1", "f_2", etc., represent the friction forces, "g_1", "g_2", etc., the gravity forces and "i_1", "i_2", etc., the unit inertia forces. The arrows indicate the directions of the forces. Having determined the numerical value for each of these individual forces, we start at the counterweight and work back to the drive pulley by adding or subtracting the forces according to the directions of the arrows, finally arriving at the value for T_2. We follow the same process around to the left of the counterweight to find the tension at A, the point of tangency with the curve. The tension at A divided by the unit weight of the belt and load (if any load) gives the minimum radius. If less than the designed radius, then it is satisfactory. Carrying the additions on to the drive pulleys gives us T_1, from which we determine whether the belt is overstressed and also from the ratio of T_1 to T_2 whether the belt will slip.

If the ratio is slightly high and the other considerations are satisfactory, perhaps a little additional counterweight will correct the situation. If the tensions are too high, we must consider controlling the motor. This may be done perhaps by reduced voltage starting or by the use of a wound rotor motor; or it may even be advantageous to build in some additional flywheel effect in the drive. This might be particularly advantageous on an inclined conveyor if fed by another conveyor that might inherently coast farther after power is interrupted, resulting in spillage at the transfer point.

Our fourth point is the influence of the normal stretch of the belt. This is best understood by watching the action of the takeup. When the takeup is going down, the head end of the belt is running faster than the tail end; when the takeup is going up, the tail end is running faster than the head end. A belt in which the motor was not properly controlled has been observed wherein the tail end ran twice as fast as the head end, during acceleration, resulting in a great amount of surging.

Figure 2 shows the characteristics of belts of different lengths all started with uncontrolled motors. The speed curves are with reference to the bend pulleys A and B, A being between the drive pulley and the takeup and B being behind the takeup, as shown in Figure 2a.

A short belt can be classified as one in which the stretch is so small the tail will start moving shortly after the head and the whole belt accelerates with the motor. This is as shown in Figure 2b.

An intermediate length belt would be one in which the tail end starts somewhat later than the head end but before the motor has attained full speed, Figure 2c.

A long belt, then, is one in which the tail end is at a standstill after the head end and motor have attained

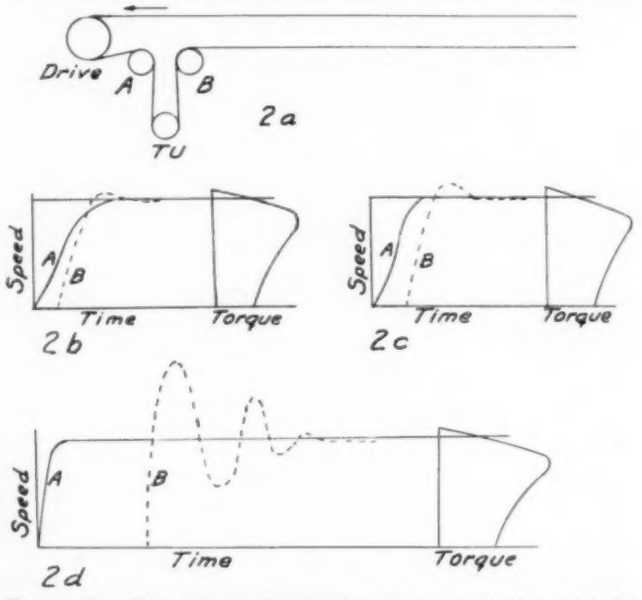


Figure 2 — Starting and stopping characteristics of belts vary appreciably as the length of the belt varies.

full speed. Figure 2d shows the surging that takes place in the tail end and which can be observed in the up and down movement of the takeup. It is under this condition, then, that we must show care in the selection of motor and control. A rough quick calculation will show whether this condition is likely to occur.

For example, assume a 1000-ft long belt geared to an 1150-rpm motor for a speed of 500 fpm. The motor would make 2.3 revolutions for 1 ft of belt travel. If this motor at full voltage and no load can accelerate to full speed in 0.39 sec it will have made 3.73 turns. That is, it would have moved 1.624 ft of belt at the drive

pulley. If the expected stretch is one per cent, this would mean that the speed of the belt would be 500 fpm at the pulley and the belt would be at standstill 162.4 ft from the head pulley.

There are several methods in use for handling the drive for this type of conveyor, each of which has one or more undesirable features. The best control arrangement consists of a wound rotor motor with a combination of primary and secondary resistors which give a straight speed torque curve of constant torque used in conjunction with an eddy current clutch or a traction-type fluid coupling, so arranged as to provide an artificial load at a very much reduced speed until such time as the entire belt is underway. This means that the full torque load is on the motor. At this point the artificial load is removed, leaving a relatively small margin of

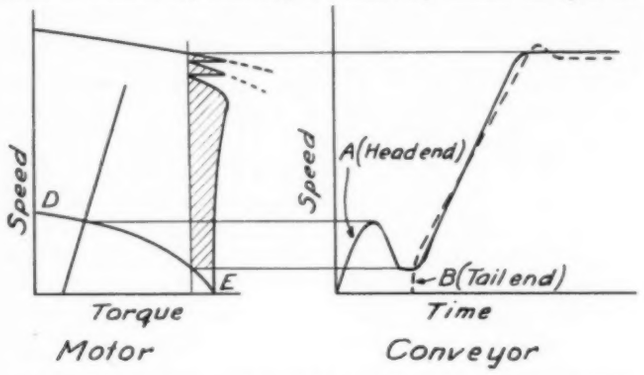


Figure 3 — Because of stretch, head and tail ends of belts may start at different rates.

torque available for acceleration. The entire belt accelerates at a reasonable rate without serious surging of the tail end, as illustrated in Figure 3.

The shaded portion is torque available for acceleration. D-E is the combined speed-torque curve on which motor runs until the entire conveyor is moving.

Another type of drive in which belt stretch is a factor is the dual motor tandem drive. It is not generally appreciated that a belt runs at a different speed at T_1 than at T_2. Since the belt is contracting under the lesser tension at T_2, it runs more slowly as it comes off the drive pulley than it starts around the pulley. This difference is speed changes with a change in load. This difference in speed is equal to the difference in per cent of stretch at the two tensions. In order to maintain a nearly constant tension between the two pulleys and to be able to control the division of loading at full load, the best drive arrangement is one wherein the secondary pulley circumferential speed is made higher than that of the primary pulley, either by a lower reduction or an increased diameter, and then to drive the secondary pulley by means of a wound rotor motor in which some slip resistance has been added. This permits of field adjustment which, once made, remains fixed. Where this was not done, objectionable vibrations were set up in the drive.

Belt stretch necessitates delayed starting of belts in a system of belts which are long enough that the tail end does not start simultaneously with the head end. Under no load this would cause no trouble, but in starting fully loaded there would be serious flooding at each transfer point.

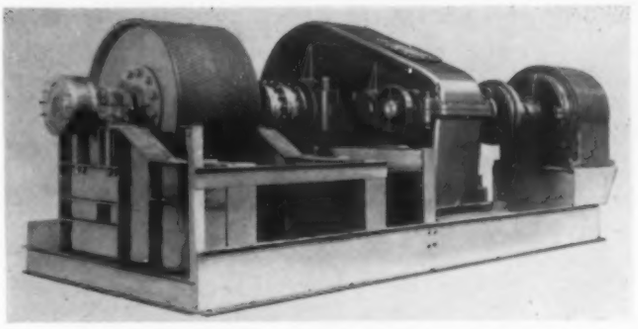


Figure 4 — Designing drives for belt conveyors requires experience with this type of equipment.

Inclined belts do not present as serious starting problems as horizontal belts because the load, resting against a backstop, has already put a large amount of stretch in the belt.

The determination of friction values for belt conveyor calculations can be quite critical. For an inclined belt it is not so important because it is small when compared with the gravitational load. In a horizontal belt the horsepower requirement depends almost entirely on the friction. On a slightly declined belt, an error in figuring friction might result in having the drive installed at the wrong end. On declined belts which regenerate, the drive is placed at the tail, or loading, end. This then introduces the problem of supplying sufficient tension at the loading point to avoid excessive sag, for when running empty, the tension on the carrying side is less than on the return side. The tension of course increases as the belt becomes loaded. In this type of drive a low torque is provided which is sufficient to bring the empty belt to full speed. A speed-sensitive switch connects the motor across the line at synchronous speed to prevent runaway in case the conveyor is started loaded.

The real problem is the so-called "Dipsy Doodle." This type of conveyor is one having combinations of inclined, horizontal and declined paths. It must be carefully studied to determine the correct location of the drive and brake and to be sure there is no sagging of the belt at critical points during starting and stopping. This is especially important when the belt makes a change from decline to incline. The study must include part loading as well as full loading.

BRAKING

Occasionally there is the problem of stopping a belt by means of a brake. Usually on inclined belts, stopping is quite fast under the influence of the load and only a backstop of some sort is required to prevent reversal of the belt. It is interesting to note that on a dual motor tandem drive it is a must that the backstop be on the secondary drive. It may be supplemented by one on the primary drive, but a single backstop on the primary drive is totally ineffective. This is because a slight contraction of the belt between the two drives will start the secondary drive backward, causing a complete loss of tension on the low tension side of the primary pulley. This results in slippage around the primary pulley which continues to increase until the entire load is dumped at the foot end.

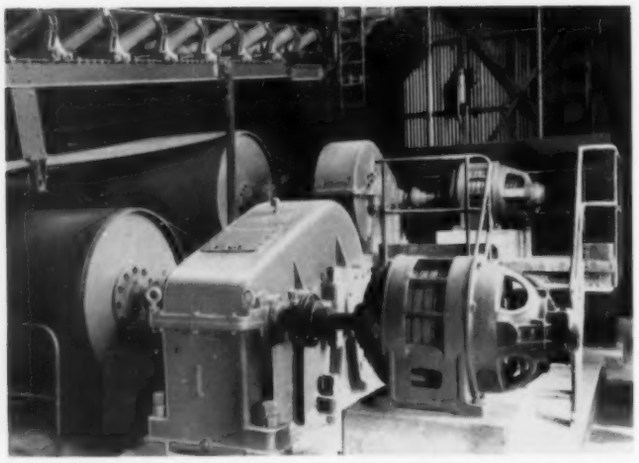


Figure 5 — Inclined belts are not as difficult to start because of the stretch already in the belt even in the stopped position.

Some engineers insist on electrically operated brakes for backstops. When used as such it is desirable to use a brake having means for controlling the setting so that it is set about the time the conveyor comes to rest; otherwise, too sudden deceleration will cause slipping of the belt around the pulley and a slack tension which might cause some spillage.

On declined belts the drive and brake are both at the tail or loading end. In this case it is necessary only to provide sufficient braking torque to stop the belt in a reasonable distance and to provide sufficient traction on the pulley to prevent slippage of the belt. Too long a decelerating period is likely to over-heat the brake wheel.

Here again, the horizontal or slightly declined belt presents the most difficult problems. With the drive at the head or discharge end, it is not desirable to apply the brake effort to the head pulley for the reasons mentioned previously. The logical place for the brake is at the tail end; but this requires a great deal of wiring between the motor and brake. Furthermore, the brake must be geared up, which is undesirable, or an expensive type of slow speed brake would have to be used. The next device would be a slow speed type of brake mounted on the bend pulley just back of the takeup. This would minimize the wiring but probably complicate the pulley system, as a 90-degree wrap would probably not be sufficient. Furthermore, the belt would be stretched along the entire return run as well as on the carrying run and the tail shaft and bend shaft would have to be heavier than normal.

MULTIPLE CONVEYOR SYSTEMS

Multiple conveyor systems present all the problems of the single conveyors plus a few additional problems of their own.

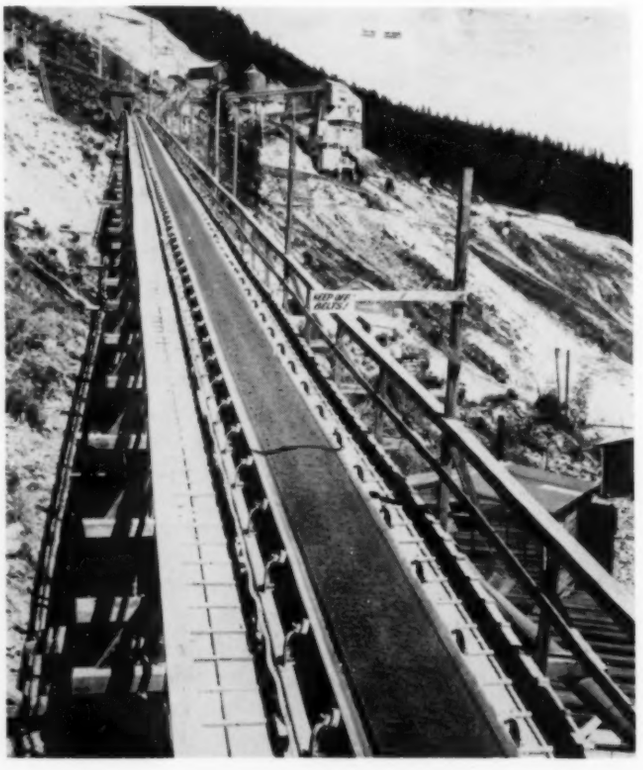
On cross-country runs it is generally attempted to design the units in such a manner that the drives will be identical. This will probably result in a series of conveyors of many different lengths, inclines, declines and combinations of all three.

In some slope installations and some level country installations, the conveyors and drives are all identical. In these cases the coasting distance should be about the same, so that no special provisions need be made to provide against spillage at the transfer points.

Systems of this sort lend themselves readily to a simple sequence control. The conveyor at the discharge end is started first. After this conveyor has attained nearly full speed, the second conveyor is started through an interlock connection on its starter and a plugging switch or flyball governor switch. Number three starts after number two has attained full speed, and so on along the line. Feeders are controlled locally but are interlocked with the conveyors to which they feed. Due to the inherent differential between pick up and drop out of the speed switches, there would be considerable spillage at transfer points when any conveyor is shut down due to overload or emergency stop, were it not for the starter interlocks. Normal stopping is to cut off the feed, run all conveyors empty, and stop.

A little more elaborate system which gives a little better power economy provides a timing relay at each conveyor drive. When the normal stop button is depressed, the feeder is stopped immediately. The last conveyor is stopped through the action of the timing relay which is set for the time required to empty the belt. Each belt is stopped in this manner until the entire system is emptied. In a system of ten conveyors, each 3000 ft long running at 300 fpm, this means savings of 90 minutes on the last conveyor, 80 on the next and so on to the first conveyor. In a straight sequence system such as this the first conveyor would run for ninety minutes before it received material. With some additional complications the system could be set up to permit starting the last conveyor and just before it started feeding to the next conveyor automatically start the next conveyor, at the same time setting up the sequence interlocking. This would be carried on to the

Figure 6 — Belts offer dependable transportation regardless of the weather.



first conveyor with the system finally all in sequence interlock.

In order to avoid excessive voltage drop in the long control circuits, sensitive relays are used to relay the controls. Since these relays require a very small current, it is necessary that they be located at the opposite end of the line from the transformer from which they take their power, so that they do not remain closed due to the small current due to the capacitance of the control line.

No matter how perfect the control system is for normal operation, it must not be overlooked that there will be emergency stopping and stoppage from power failures. These possibilities introduce the necessity for thoroughly studying each conveyor to learn how much it coasts with respect to the two adjacent conveyors. Coasting may be corrected by the addition of a brake or additional flywheel effect, depending on which is appropriate. If spillage is not too great and occurs very infrequently, it may not be too inconvenient to shovel it up.

If material is being fed to the belt system at more than one point, it is necessary to make provision for not overloading the system. If the maximum capacity of each of two feeders is one-half the capacity, there is no danger of overloading, but feeders are sometimes set up so that either one may take all the load or perhaps the larger portion of the load. Here again it is only a matter of interlocking if multi-speed motors are used. It is a more serious question if adjustable speed drives are used. Speed or tonnage meters for both drives at both operators' stations, together with a good communication system, take care of this condition.

Basically there is not much difference between a long cross-country conveyor system and a large stocking out and reclaiming system. The latter has all the problems of the former plus the additional problems of interlocking through flop gates, traveling stackers, booms, etc., and the introduction of breakers, crushers, screens, magnetic devices for tramp iron extraction, dust collectors, samplers, scales, etc.

These systems can become quite complicated when some of the conveyors are used for both stocking out and reclaiming and may be reversing and perhaps handling different tonnages. They are further complicated when made of parallel systems with crossovers at every possible place to provide maximum flexibility and minimum danger of complete shutdown.

Control of these systems may be from one or more locations. At each location, a bench board is provided on which is a flow diagram covering the portion of the system to be controlled from that point. A very good control board in use has a flow diagram consisting of transparent plastic strips illuminated from the back side. The strips show green when the breaker is closed indicating the motor is ready, and show red when motor is running. A selsyn driven disc on the board shows the motion of the coal breaker and makes it easy for the operator to rock the breaker if necessary to get it started. Less elaborate boards may have bakelite strips or painted stripes with indicating lights spotted in them. Whatever the system, it enables the operator to set up the proper sequence for the system, such as selecting gate positions, what units are to run and at what

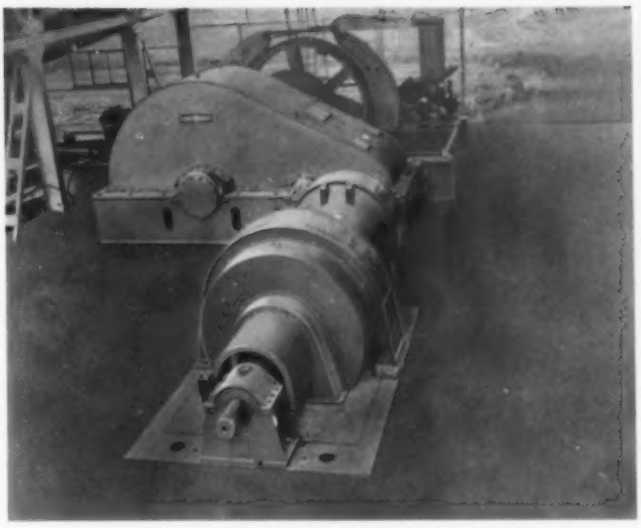


Figure 7 — The horizontal belt gives the worst braking problems.

speeds. Interlocking is automatically set up so that no damage can be done through improper operation.

Where surge bins are used to allow for some downtime for manipulations at the discharge end of the system without shutting down the entire system, it is necessary that the conveyors carrying the material from the surge bin be designed for higher than the system capacity. Otherwise the material in the bin will not lower to make room for the next charge. While considerations of this sort are obvious, they are sometimes overlooked.

A little ingenuity can save a lot of collector rails along a traveling stacker. A particular stacker recently installed has a belt conveyor, automatic rail clamps and traversing motors. The units operate automatically, and the belt conveyor is interlocked to the conveyor from which it receives material, all through the three power rails, from a remote location not on the stacker. No trick carrier current relaying is used.

Another problem encountered with stocking out or ship loading traveling trippers is how to dispose of the material on the main belt which is not running, but is loaded, when the tripper is moving contrary to the normal direction of the belt. The solution of course depends on the particular requirements of the system.

Figure 8 — River crossings offer no problems to conveyor transportation.

The introduction of magnetic devices for protection or reclamation of tramp iron adds to the problems. These devices may be detectors, magnetic pulleys or suspended magnets. Each has its advantages and disadvantages.

The detectors will spot any kind of metal, ferrous or non-ferrous, but require auxiliary equipment to eject the piece or require that the belt be stopped.

Magnetic pulleys continuously eject the magnetic material but not the non-magnetic. They set a limit on the arc of contact of the belt because the snub pulley must be kept far enough away to allow the magnetic materials to drop off. Fines are carried over with the magnetic materials sometimes in such quantities that they must be screened out and reclaimed. Making room

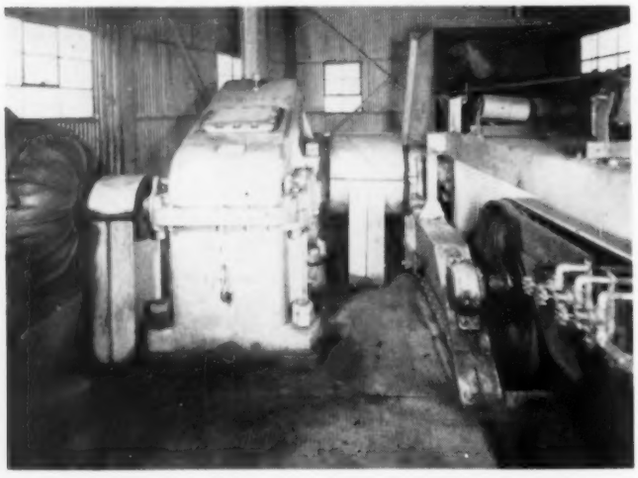


Figure 9 — Drive centers are usually enclosed.

for the screen increases the elevation of the head pulley, which makes for longer belts, higher transfer houses and more horsepower.

The usual suspended magnet must be watched and cleaned when there is an accumulation of tramp iron on it. Auxiliary equipment must be furnished to protect against dumping its burden in case of a power failure. This may be accomplished by using an auxiliary winding connected to a storage battery or by means of a flywheel motor-generator set and a trigger-operated catch to release the magnet, permitting it to coast down an incline where it drops its load in a pan.

A development which is receiving increasing consideration is the suspended self-cleaning rectangular magnet. A motor-driven belt across the face of the magnet cleans the tramp iron off as soon as it is picked out of the material stream. The magnet can be designed for a much greater depth of field with a smaller wattage than the pulley type. Fewer fines are carried over with the tramp iron, thus eliminating the screening. Head room is reduced and more wrap and better cleaning of the belt can be obtained at the drive pulley.

These magnetic devices are interlocked into the belt system by means of a series relay which closes the interlocking circuit only if there is current flowing in the coil. Voltage relays do not insure the magnet is energized.

Safety devices are many and varied, running all the way from pull cords to counterweight catching devices. Every engineer and operator has his own ideas as to what safety measures should be taken. Some want to stop the belt if it drifts too far off center. Others want protection against belt breakage or slippage. There is a great difference of opinion as to emergency stopping, varying from pull cords all along all conveyors to strategically located stop push buttons. Pull cords over belts in tunnels are good in case of roof falls. Alongside a conveyor they may or may not be accessible to a man caught in the machinery. Too many stop connections in a circuit may be a constant source of hard-to-locate troubles. It is desirable that emergency stop buttons lock out. With this type it is readily determined which button was operated and only authorized personnel can reestablish the circuit after the trouble has been corrected.

Wet belts have been known to freeze to the drive pulley when not running—resulting in considerable damage upon starting. In one case this trouble was overcome by the addition of an auxiliary drive which keeps the conveyor moving slowly during the time conditions exist which are likely to result in this difficulty.

A number of types of backstop devices are available to prevent backward movement of inclined belts when stopped under load. These may be electrically operated brakes, differential band brakes, free-wheeling types or ratchet and pawl types.

Mention was made previously of a counterweight catching device. This device was developed for use in installations in which the counterweight, if released due to breakage of the belt, could fall through several floors, endangering lives and machinery. A trigger mechanism causes clamps to engage the guides when pressure is relieved.

POWER DISTRIBUTION

The manner in which power is distributed to a long conveyor system is determined partly from economic and partly from safety considerations. In some cases 2300 or 4160 volts are taken directly from the line to the motor without transformation. In other installations it may be stepped down at each drive to a lower voltage, especially if there are other smaller motors such as sump pump, welding motor-generator sets, power driven brushes, etc.

In compact systems, some customers specify all motors over a given horsepower rating to be 2300 volts or 4160 volts and the smaller motors to be 440 or 220 volts. In other systems all motors are 440 volts and the higher voltage distribution is brought to strategically located transformers. The use of molded case breakers in the final distribution makes it desirable, if possible, to limit the transformers to 750 kva. Above this size

Figure 10 — Many belts are used by the steel industry to handle the products from its mines.

it is necessary to carefully study possible short circuit current values and their relation to the interrupting capacity of the breakers. If the control centers are very close to the transformers, it may be necessary to increase the transformer impedance or add load limiting reactors in the appropriate feeders. Otherwise larger and more expensive breakers may be required. Where banks of transformers are used, they are arranged with key-interlocked tie breakers for maximum flexibility.

MECHANICAL PROBLEMS

There are several details that must be given special consideration in every belt conveyor installation. These include protection at the tail end to guard against lumps falling on the belt before it goes around the tail pulley, most effective location of takeup for quickest response, feeding with minimum scuffing of the belt, central and uniform feeding, cushioning at feed point, smooth flowing transfer from belt to belt, cleaning of belt, disposal of dribble, bends that might overstress the belt edges, avoiding sagging due to insufficient tensions under all possible conditions of loading, adequate radius at bends, trajectories, skirt boards, magnetic separation, weighing, sampling, dust collecting, coasting, accelerating, belt stretch, belt shrinkage, takeup travel, etc.

With all these factors it would appear that a belt conveyor system might be a source of continuous trouble. However, with correct design, proper erection and adequate maintenance, a belt conveyor system is an extremely economical and highly satisfactory method for handling large volumes of bulk materials.

DISCUSSION

PRESENTED BY

J. J. W. BROWN, Materials Handling and Testing Equipment, Industrial Engineering Section, General Electric Co., Schenectady, N. Y.

P. R. GRAVENSTRETER, Electrical Engineer, Applied Engineering Dept., The Clark Controller Co., Cleveland, Ohio

J. J. W. Brown: Mr. Heacock has brought out the very important point that the electrical drive and the belt cannot be engineered separately but must be carefully coordinated to obtain satisfactory starting performance without overstressing the belt.

Mr. Heacock's paper brings out quite well with the data presented, that the accelerating characteristics of the electric drive are of particular importance when relatively long length conveyor flights are being considered. Mr. Heacock's scheme of using a combination of primary resistance and secondary resistance control of a wound rotor motor has always been most intriguing since it provides theoretical characteristics very closely approaching the ideal insofar as the belt manufacturer's maximum tension specifications are concerned. We have provided the electrical equipment for such drives and they have been eminently successful. However, they must be applied with discretion and the engineering of the electrical drive must be quite carefully done in order to take into account the effects of primary voltage supply variations. As can be seen, the successful starting of the conveyor depends upon the flat part of the motor speed torque being just over the load torque. Since the motor torque will vary as the square of the primary voltage, a severe dip in primary voltage might prevent the drive from starting until the final secondary resistance steps come into play. However, a belt conveyor does not start all at once. Due to the elasticity of the belt, it is more like starting a train of railroad cars, the initial movement going down the belt from the head pulley like a wave. This minimizes any excessive starting torque being required to overcome static friction. With close attention to engineering details, the combination primary and secondary resistance control will prove a most successful drive.

As Mr. Heacock mentioned, some long distance belt conveyors of several belt flights use higher voltage motors, say 2300 and 4000 volts, so that these voltages can be used for the distribution system along the conveyor. Primary resistance control for these installations becomes relatively expensive due to higher cost for high voltage contactors.

Another type of control which has been quite successfully applied to long belt conveyors involves the use of wound rotor motor with motor-operated controller having a large number of secondary resistance steps. A standard primary starter is used. This motor-operated controller is much more economical than providing the same number of steps (14 to 20) with secondary contactors. With this large number of steps the conveyor can be accelerated up to speed and still keep the torque peaks to values acceptable to the belt manufacturer. This eliminates any long flat portion in the motor speed-torque curve since the controller will automatically notch around to the next point and increase the motor torque in case the belt does not start to move on the first point. Therefore, this type of drive is relatively insensitive to supply voltage fluctuations.

When electrically operated brakes have been specified for belt conveyors, we have always recommended a thrustor operated, spring set shoe brake. With the orifice adjustment on the thrustor, the setting of the brake can be delayed over quite a range. This can be adjusted quite easily on the job to obtain the braking characteristics required.

P. R. Gravenstreter: After reading the author's thorough and informative paper, it appears that some additional comment is indicated. The mechanical problems and their association to the electrical problems involving induction motors are clearly defined to the exclusion of other possible systems.

Most problems involving machinery drives are concerned mainly with acceleration and deceleration. Speed match of sections of the drives is sometimes a problem, but usually is considered secondary to that of starting and stopping.

Long belt bulk material handling conveyors are no exception to this rule. When the facts are studied, the control engineer is asked for his views and opinions regarding the problems.

In most cases involved, the flexible drive system, known as the adjustable voltage system, must be considered as a contender for the drive. Acceleration prob-

lems, maximum belt tension for example, can be controlled to a finite value, not exceeding the set value at anytime, be it January or July. The mass of friction producing parts, principally idler rolls, are particularly bad actors with temperature variations. In considering induction machines, available torque is in some way related to the slip, and is not uniform. Adjustable voltage produces programmed torque based on any factor-time, speed, temperature, etc., and can be used to advantage in belt conveyor systems. Smooth stepless acceleration is possible which materially reduces the problem of hunting or surging. Anti-hunt devices, measuring the position of counterweight, differentiating the rate of change of position can be supplied to correct for the factors causing hunting. On double motor drives sharing of loads during and after acceleration is facilitated through the use of control in motor shunt fields.

Conveyors to handle materials of dissimilar weights per unit volume may require speeds to be adjustable in order to maintain maximum tonnage. Slight changes in relative conveyor speeds may be of an advantage as changes occur in the material being handled even though the product is basically the same.

Of considerable merit in belt control is the advantage of controlled stopping. Regenerative braking and its associated characteristics can be utilized here to best advantage. Characteristics of each belt may allow for stopping times unlike the starting times. With an adjustable voltage system, both regenerative manual stop and unnatural emergency stop sequencing can be arranged to minimize spilling.

Sequencing can be accomplished in like manner as with induction motor control. Fault finders at the master operator's station are a big factor in time saving should an outage occur.

Economic factors usually influence the design of any electrical drive system. In comparison, the adjustable voltage system is a standoff if the motor-generator set is not considered. The motor-generator set could be balanced with the distribution transformers. High voltage synchronous or induction motor-generator sets are available for operation at increased voltages, saving the distribution equipment.

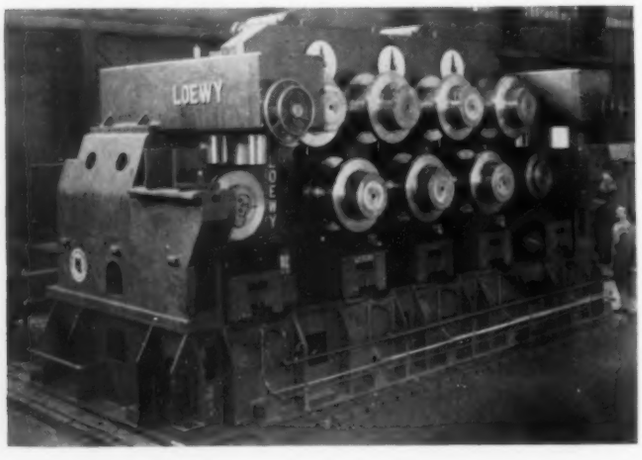
RAIL STRAIGHTENING ON ROTARY MACHINES

By THEODOR WUTSCHER, Chief Designer, Loewy Rolling Mill Division, Hydropress, Inc.

▲ IN this country and Canada, rails are straightened exclusively on gag presses, and therefore some of the steel plants have not been anxious to roll rails longer than 60 ft. In Europe the question of straightening rails has been investigated and definitely decided in favor of the roller straightener. Extensive tests have shown that the efficiency of a heavy-duty roller straightener of modern design is eight times higher than gag straighteners and increases with the length of the material. For this reason, 100 ft is generally the standard length of rails rolled in Europe. The output of finished products on these machines is as high as 95-98 per cent, depending on the condition in which the rails are delivered from the cooling bed.

Our company has done much in the development of roller straightening machines for all kinds of structural sections, including wide flanged beams up to 24 in. and rails up to 175 lb per yard. The use of overhung straightening rolls, not only for small or medium sized, but also for the heaviest straightener may be regarded as the most important development in the design of roller straightening machines. The straightening rolls, pre-assembled on sleeves, can easily be exchanged in a very short time by means of a special roll changing rig and the whole straightening process can readily be observed by the operator stationed in front of the machine.

Heavy duty roller straightener handles rails and wide flanged beams.



The machine, illustrated, has a roller pitch of 53 in. with nine straightening rolls and two pairs of vertical guide rolls. All roll shafts are in roller bearings and equipped with adjustable roller thrust bearings of sufficient capacity to insure that the desired straightening effect on the material in both planes which is accomplished by suitable staggering of the straightening rolls. The vertical and horizontal adjustments of the rolls are power driven and push-button operated, the adjustment being recorded on clearly visible dials, located in front of the machine. This straightener is a rugged unit of all welded design.

The main drive, which is incorporated in the housing of the straightener, has suitably arranged high precision gearing divided into two groups, each of which is driven by a separate motor mounted directly on the machine. This arrangement prevents extreme overloading of the driving gears due to friction-locking of the rolls in case of slightly varying roll diameters, when the material is passed through the machine. At the same time, this design makes the straightener and drive one compact unit which requires a minimum of floor space.

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ALUMINUM COATING PROCESS Developed for Iron and Steel Wire

by BERNARD S. WESTERMAN

▲ THE resistance to atmospheric corrosion and heat oxidation afforded by aluminum has served as the incentive for the development of commercial processes for the application of protective aluminum coatings on iron and steel. A practicable commercial process for the coating of sheet and strip has been developed within the past several years. Also, batch processes have been developed for coating irregularly shaped articles such as castings, forgings, stampings, etc., of ferrous metals and alloys. More recently, attention has been centered on the development of practical processes for the continuous hot-dip application of aluminum to iron and steel wire.

Some hot-dip aluminum coating processes utilize either controlled gaseous atmospheres to protect the cleaned metal surface from oxidation until the article is immersed in the molten aluminum bath; others utilize the strong fluxing action of molten salts either as separate baths or as layers of molten flux underneath or over the molten aluminum.

The Page Steel and Wire Division, American Chain & Cable Co., Inc., has developed, and has patents on, a continuous hot-dip aluminum coating process for iron and steel wire based on the fluxing action of complex salt compounds applied to the wire surface from a hot aqueous solution.

This aluminizing process, which is practicable from a production standpoint as well as economical in cost, consists of the following:

1. Preheating.
2. Cleaning and pickling in hot acid solutions.
3. Rinsing in hot water.
4. Application of flux by immersion of wire in a hot aqueous salt solution.
5. Immersion in molten aluminum bath, the wire being withdrawn vertically to assure the uniformity of the applied aluminum coating.

Pretreatment—Wire surface cleanliness is of paramount importance in the application of continuous hot-dipped aluminum coatings. Residual films of drawing lubricant on the surface of hard drawn wire are insoluble or only slightly soluble in commercial degreasing solutions and vapors as well as cleaning and acid pickling solutions. Heat imparted to the wire during this pretreatment accelerates subsequent cleaning and pickling in acid solutions. Pretreating temperatures are based on the wire size, speed of travel, length of furnace, etc. It is necessary also to adjust the furnace

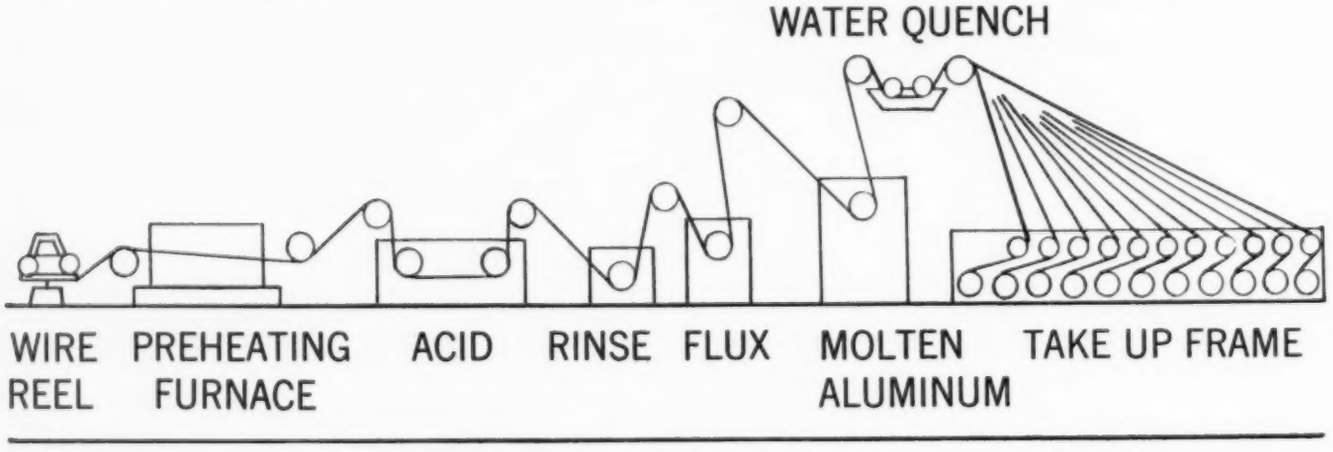

Figure 1 — Schematic layout of aluminum coating unit.

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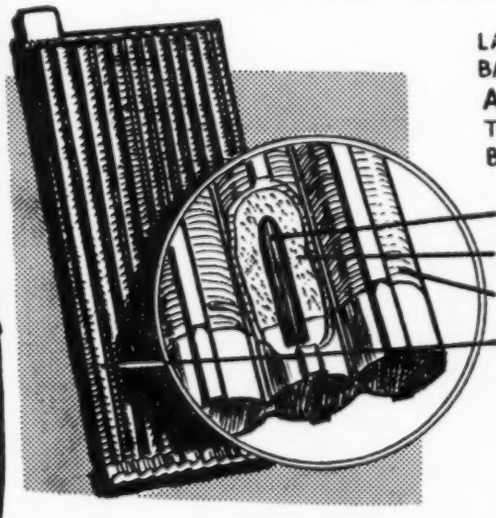

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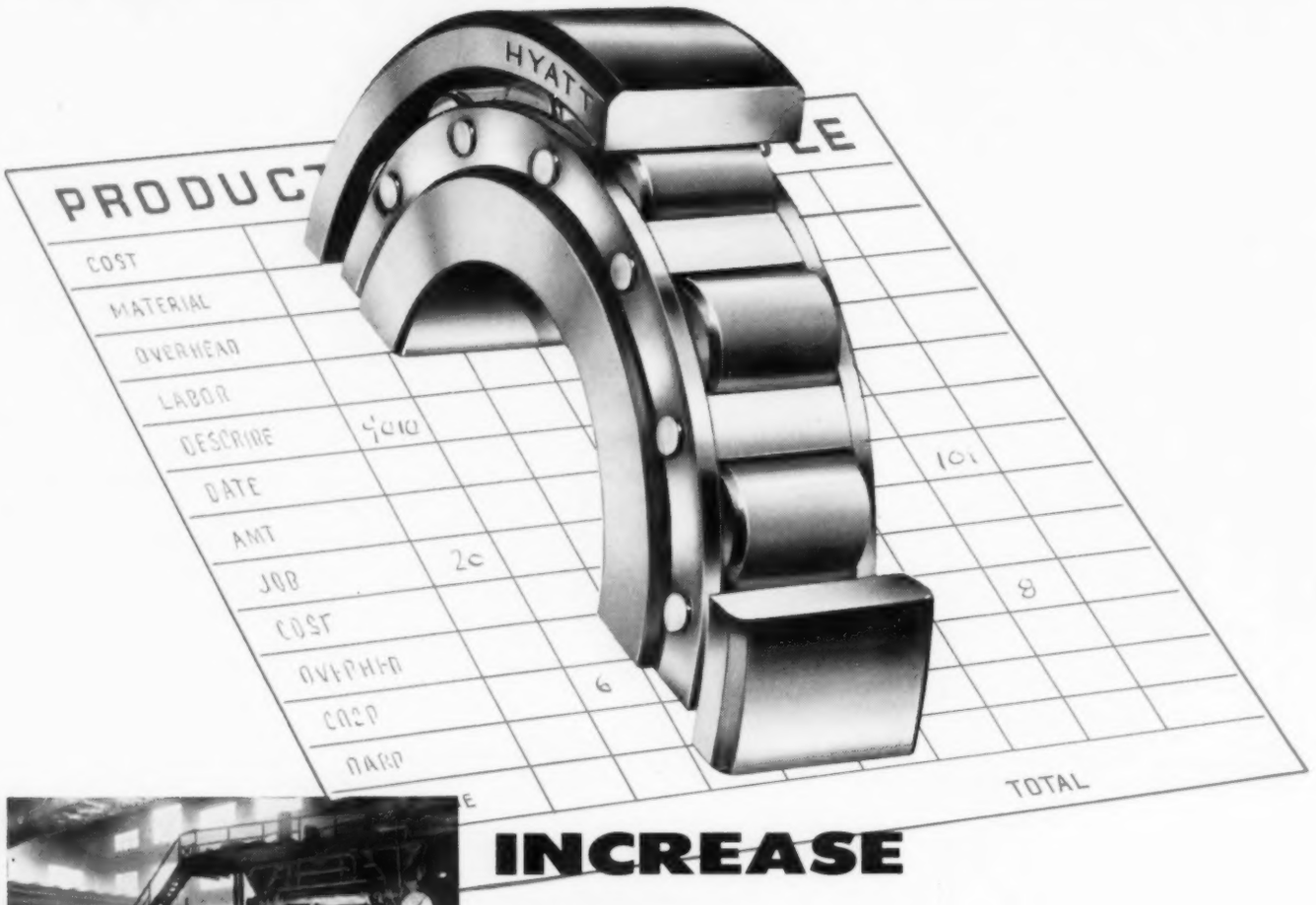

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so as to avoid adverse effects on the physical properties of the wire so treated.

Cleaning and Pickling in Acid Solutions — Immersion of the preheated wire in acid cleaning and pickling solutions permits the rapid removal of all oxidized surface contaminants including the remnants of lime if utilized for drawing. Surface soil, if permitted to remain on the wire, imposes a barrier to the intimate contact of the molten aluminum with the wire surface, thus preventing the application of continuous coating. Best results have been obtained with hot hydrochloric acid solutions, the temperature and concentration of which must be suited to the wire size, speed of travel, length of acid pickling tanks, nature of the wire surface, etc.

Hot Water Rinsing — Following acid cleaning and pickling, the wire is rinsed very thoroughly in hot water to assure the removal of iron salts and such adhering dirt as may be carried on the surface of the wire.

Fluxing—The flux utilized in the ACCO aluminizing process is a hot aqueous solution of zirconium or titanium fluorides or complex zirconium or titanium fluoride compounds with an alkali metal such as sodium or potassium. The temperature and concentration of the flux solution may be varied to suit the diameter and speed of the wire. It is desirable to maintain the temperature of the flux bath high enough to dry the flux on the wire as it passes through air after leaving the flux bath. It is necessary that the flux coating on the wire be quite dry before the wire enters the bath of molten aluminum to avoid serious agitation of the aluminum at the point of entry with accompanying accelerated formation of aluminum oxide skimmings. Provision is made for the application of flux in a uniform film on the wire.

Hot-Dip Application of Coating—The fluxed wire enters the molten aluminum bath, passes under a suitable sinker, and leaves the bath vertically to assure uniformity of coating. The time during which the wire remains immersed in the molten aluminum, which is regulated by the immersion length and the speed of travel, affects the thickness of the aluminum-iron alloy layer formed. The wire size and speed of travel affects significantly the total thickness or weight of the applied coating.

Figure 2 — A wire drawer at the Monessen, Pa. plant of American Chain and Cable Co. regulates the drawing of aluminum-coated steel wire onto spools.

The molten metal is contained in a low frequency electric induction furnace. Relatively high purity alumina brick is the refractory used for the furnace lining. Advantages accruing from this type of furnace include the long refractory life as compared to the relatively short service life of externally heated or fired metal pans, uniformity of temperature throughout the bath by reason of the circulation of the molten metal through the inductor channels, the absence of dross sediment on the bottom of the furnace, close temperature control, etc. The necessity for the daily cleaning of the inductor channels to remove aluminum oxide as well as the periodic shutdown and partial draining of the molten metal below the throat to permit the removal of aluminum oxide from the horizontal channel connecting the inductor channels provide the major adverse characteristics of this type of furnace.

Commercially pure aluminum or aluminum to which alloys have been added may be used. A molten bath of commercially pure aluminum may be maintained at a temperature of 1250 to 1400 F for the application of satisfactory coatings; the addition of some alloys permits a reduction in the operating temperature consistent with the amount added.

Coating Ductility and Adherence —These characteristics provide the most troublesome problems in the production of most commercially acceptable hot-dipped metal coatings on iron and steel wire. Ductility is appraised by the ability of the coating to withstand elongation without cracking; adherence is the ability of the coating to withstand bending, wrapping, and other forming operations without peeling or flaking.

Important factors controlling the

Figure 3 — Manufacture of aluminized barbed wire started recently at the Page Steel and Wire Division of American Chain and Cable Co., Monessen, Pa. The product is said to last two to six times as long as galvanized wire of equal coating thickness.

ductility and adherence of aluminum coatings on iron and steel wire are as follows:

1. Thickness and hardness of the alloy layer as a result of the chemistry of the molten bath and wire as well as the immersion time in the molten bath.
2. Chemistry of the molten bath as related to the applied coating.
3. Coating weight and thickness, smoothness or regularity, all being a function of speed of wire travel in continuous coating operations.
4. Wire size.
5. Grain size and structure of the coating at room temperature.

Hot-dipped aluminum coatings applied to iron and steel wire are duplex in nature consisting of an alloy layer resulting from a diffusion process and an outermost layer having a chemical composition similar to that of the bath; the latter layer is characterized by a cast structure. The alloy layer is hard and brittle; these conditions in combination with alloy layer thickness exert a controlling influence on coating ductility and adherence. To improve these properties, the thickness and hardness of the alloy layer, which is responsible for brittleness, must be reduced. Alloy layer thickness can be reduced to some degree by decreasing the immersion time of the wire in the bath and by reducing the bath temperature; alloy layer hardness may only be reduced by the addition of alloying elements to the bath. Investigators have shown that silicon and beryllium are the most effective additives in reducing the hardness and inhibiting the formation of alloy layer. The toxicity of beryllium introduces serious problems in connection with its use. In continuous wire coating operations, major improvement in ductility and adherence of the coating is evident with silicon additions up to about 2.5 per cent. Above this amount, no further significant benefits are evident.

Coating weight or thickness, smoothness or regularity, are controlled by the speed of travel of the wire during the continuous application of the coating. As the speed of travel increases, the weight of applied coating also increases and the coating becomes more irregular in thickness. At high speeds, the coating is characterized by variations in thickness which are probably caused by the flow characteristics of a relatively large volume of applied molten aluminum as well as vibration in the system. The heavier or thicker coatings, characterized by irregularity, show a greater tendency toward cracking and peeling than do the thinner smoother coatings.

While control of coating ductility and adherence is exercised by the reduction of the hardness and thickness of the alloy layer, for optimum coating characteristics, the outermost layer should consist of a fine-grained matrix of aluminum or aluminum alloy, similar in composition to the molten bath, with the aluminum-silicon-iron or aluminum-iron compound well distributed as fine particles.

The size of the wire also exerts an influence on coating characteristics. For a given speed of wire travel, the larger the wire size the heavier or thicker and the more irregular may be the applied aluminum coating. In general, heavy or thick and relatively irregular aluminum coatings on the larger sizes of wire show a tendency toward brittleness.

Hot-dipped aluminum coatings applied by this aluminizing process are appraised for ductility and adherence by means of the wrap test in which the wire is wrapped around a mandrel whose diameters are multiples of that of the coated wire. The coating technology is adjusted so that insofar as possible all coatings will pass the one diameter wrap test. However, under most conditions, the applied aluminum coating will meet wrap test requirements applicable to equivalent thicknesses of hot-dipped zinc.

Satisfactory hot-dipped aluminum coatings may be applied to wire of various sizes so as to comply with the requirements of Class A zinc coatings specified by the American Society for Testing Materials. This comparison is made on the basis of equivalent thicknesses of zinc and aluminum coatings rather than equivalent weights of coating by reason of the fact that aluminum is lower in specific gravity than zinc. Aluminum coatings equivalent in thickness to coatings of zinc of about 1.25 to 1.5 ounces per sq ft of uncoated wire surface have been successfully applied to sizes of wire 0.135 in. and larger, the coating being characterized by satisfactory ductility and adherence.

In general, the coating and properties of wire for standard galvanized products such as strand, chain link fabric, some grades of telephone and telegraph wire, most manufacturers' wires, and special products may be duplicated with aluminum-coated wire. In this connection, comparison of aluminum versus zinc coatings is made on the basis of equivalent coating thickness rather than equivalent weight. Most drawn galvanized wire and wire products may be duplicated with drawn aluminum-coated products.

Outdoor exposure tests in both industrial and highly humid atmospheres have not progressed to the point where the magnitude of the superiority in corrosion resistance of aluminum-coated wire compared to zinc-coated wire may be presented. However, preliminary data indicate that aluminum coatings are substantially superior to equivalent thicknesses of zinc coatings exposed in industrial and highly humid atmospheres. Salt spray corrosion data show less pronounced differences.

Aluminum coatings on iron and steel wire offer resistance to heat oxidation at relatively high temperatures. Some investigators have reported resistance up to temperatures of 1000 to 1300 F while others have indicated that this resistance extends to as high as 1600 F. In any case, to develop heat or oxidation resistance, the coated wire must be subjected to a diffusion heat treatment which converts the outermost layer of relatively pure aluminum or aluminum alloy to the same constituent or compound as the alloy layer.

The characteristics of hot-dipped aluminum coatings applied to iron and steel wire are such that a safe prediction may be made that this metal coating will assume an important place in the family of protective metal coatings offering substantial and significant advantages in the extension of service life, corrosion and oxidation resistance, on an economical basis. Continued research and development with aluminum coating processes and applied coatings will assure the importance of the role to be played in every day commercial and domestic life.

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8/28/52	93	10:20	No CORHART 104	Two large patches to walls and gunning time.
10/9/52	118	6:50	Some CORHART 104	Brick or gunning repairs.
11/7/52	103	12:05	No CORHART 104	Two large patches.
1/4/53	90	4:10	No CORHART 104	One large patch and gunning time.
2/5/53	105	4:35	No CORHART 104	One large patch and gunning time.
3/13/53	126	4:25	CORHART 104 in *"Hot Spots"*	Patching top of wall and gunning wall.
4/16/53	136	11:40	CORHART 104 in *"Hot Spots"*	Brick repair to top of walls only.
5/26/53	127	8:55	CORHART 104 in *"Hot Spots"*	Brick repair to top of walls only.
7/1/53	129	5:05	CORHART 104 in *"Hot Spots"*	Brick repair to top of walls only.
8/5/53	117	15:25	No CORHART 104	Three large patches and wall gunning.
9/23/53	119	5:10	Some CORHART 104	Brick and wall gunning.
11/7/53	137	10:05	CORHART 104 in *"Hot Spots"*	Patching top of walls.
2/17/54	105	7:10	No CORHART 104	One large and one small patch.
4/11/54	151	10:20	CORHART 104 in *"Hot Spots"*	Patching top of walls.
5/31/54	146	12:35	CORHART 104 in *"Hot Spots"*	Three small patches to top of walls.
9/4/54	135	22:30	CORHART 104 in *"Hot Spots"*	Patching top of walls.
10/8/54	143	13:25	CORHART 104 in *"Hot Spots"*	Patching top of walls.
11/17/54	135	4:05	CORHART 104 in *"Hot Spots"*	Patching top of walls.

Average heats per campaign without CORHART 104.....100
Average heats per campaign with CORHART 104 in *"Hot Spots"*.....137

THE two and one-half year furnace log above shows that, when using Corhart 104 Electrocast Refractory, the operators of this 60-ton electric furnace averaged 37% more heats per campaign. Yet the Corhart 104 represented only about 10% of the total sidewall refractory requirements!

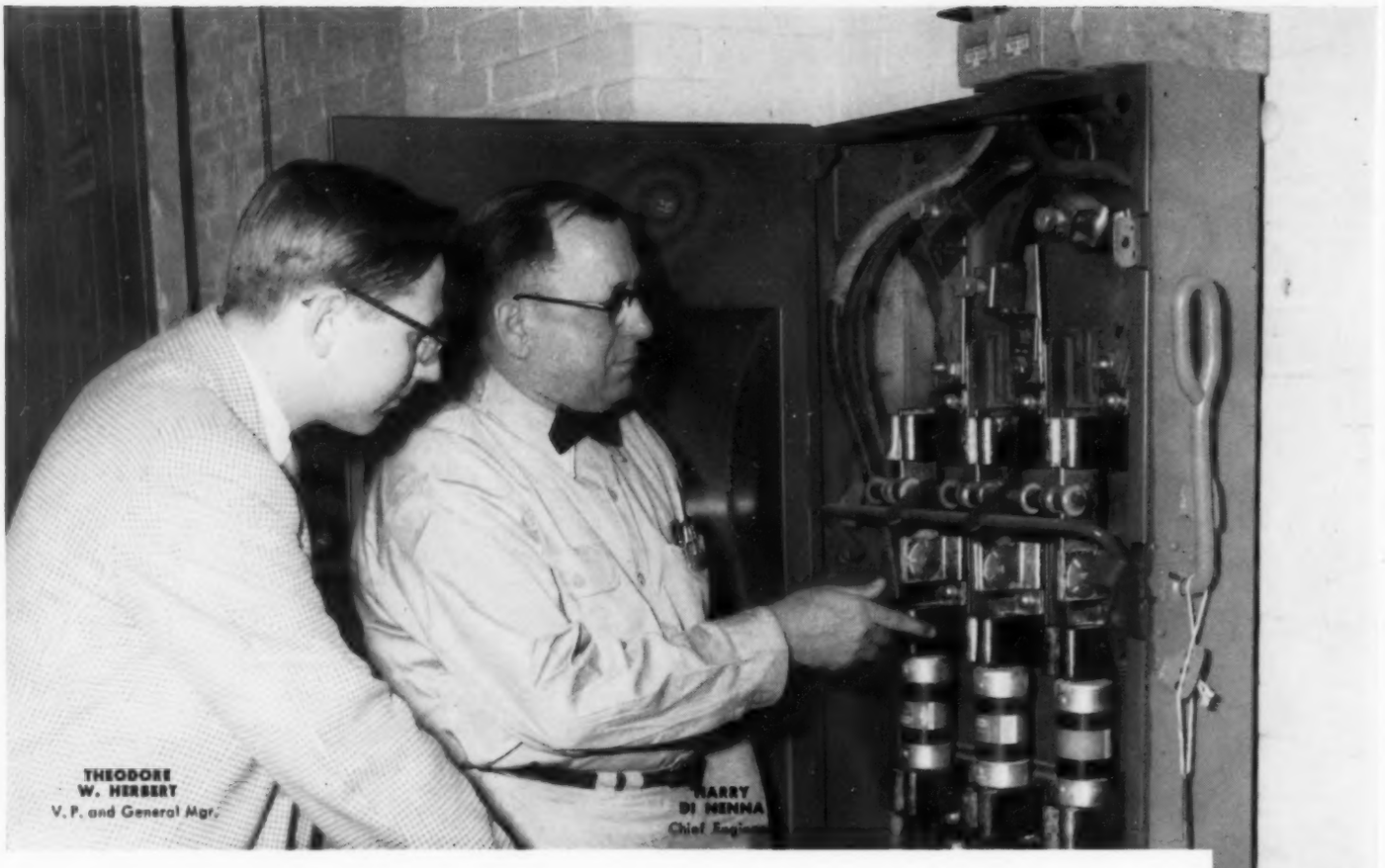
Corhart 104 is a revolutionary magnesite-chrome refractory which is electrically-melted at 4500°F, and then cast into its final shape. It is used in hot spots, to help "balance" sidewall wear in electric furnaces and open hearths.

Write for complete technical information. If you will describe your operations, we'll be glad to suggest applications and estimate costs. Corhart Refractories Co., *Incorporated,* 1620 West Lee Street, Louisville 10, Kentucky, U.S.A.

QUALITY ECONOMY ENDURANCE

CORHART 104 ELECTROCAST REFRACTORY

The words "CORHART" and "ELECTROCAST" are registered Trade Marks which indicate manufacture by Corhart Refractories Company, Incorporated.



"We can now push our equipment 24 hours a day without fuse blows causing needless shutdowns, thanks to Fusetron *dual-element* Fuses."

"When we are on a tight schedule, we must operate 24 hours a day to fill our orders. Every piece of equipment in the plant is pushed to its limit. A work stoppage of any kind is more than annoying, it is most important as we just can't afford to waste time.

"We were using ordinary fuses to protect our motors, but these fuses couldn't hold up under the pressure. They would blow often and as I now know — needlessly.

"Every time a fuse blew we were losing money. I would start figuring how much harder and faster we would have to work to get back on schedule.

"Something had to be done. We called upon Mr. Paul Serotta of the Norristown Electric Supply Company. He recommended we discard our old fuses and replace them with Fusetron dual-element fuses.

"That was the answer all right. We can really notice the difference. Now, when we are on full production basis I am not worried that our equipment will be out of operation by the needless blowing of fuses."

Harry DiNenna
CHIEF ENGINEER
HERBERT HOSIERY COMPANY
NORRISTOWN, PA.

Play Safe! install Fusetron and BUSS Hi-Cap

Fusetron Fuses Do More Than Eliminate Shutdowns Caused By Needless Blows . . .

FUSETRON FUSES PROVIDE 10 POINT PROTECTION . . .

1. Protect against short-circuits.
2. Protect against needless blows caused by harmless overloads.
3. Protect against needless blows caused by excessive heating—lesser resistance results in cooler operation.
4. Provide thermal protection — for panels and switches against damage from heating due to poor contact.
5. Protect motors against burnout from overloading.
6. Protect motors against burnout due to single phasing.
7. Give DOUBLE burnout protection to large motors — without extra cost.
8. Make protection of small motors simple and inexpensive.
9. Protect against waste of space and money — permit use of proper size switches and panels.
10. Protect coils, transformers and solenoids against burnouts.

FUSETRON FUSES SAVE YOU Maintenance and Recalibration Costs

Once properly installed, Fusetron fuses require no costly inspection time or maintenance necessary on mechanically operated devices.

Dust, fumes, corrosion or age cannot prevent a Fusetron fuse from opening safely. There are no hinges, pivots or contacts to stick or slow down the operation of the fuse on short-circuit.

When a Fusetron fuse does open to protect, and after the fault has been corrected — the new Fusetron fuse you have installed has been *calibrated at the factory by engineers* — it is a fuse as safe and dependable as the one that blew.

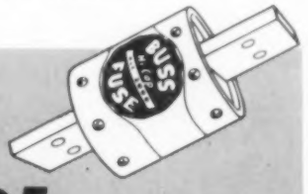
FUSETRON FUSES GIVE YOU GREATER SAFETY, BECAUSE OF THEIR HIGH INTERRUPTING CAPACITY

Tests verified by the Electrical Testing Laboratories of New York indicate that Fusetron fuses can interrupt safely the most severe available short-circuit current.

The tests circuits were set to deliver in excess of 100,000 amps. In each test the fuse cleared the circuit safely, the fuse remained intact, there was very little noise and cotton packed around the fuse was not ignited.

Yet there has been no interference with the time-lag characteristic of Fusetron fuses.

FOR LOADS ABOVE 600 AND UP TO 5,000 AMPS.,



BUSS Hi-Cap FUSES PROVIDE . . .

Unlimited interrupting capacity to handle any fault current regardless of system growth! This was confirmed by tests witnessed and reported upon by the Electrical Testing Laboratories of New York.

Overload protection as well as short-circuit protection.

Coordination with Fusetron fuses on feeder and branch circuits to limit fault outages to circuit of origin.

On old installations, a safe and relatively inexpensive way to protect inadequate circuit breakers against rupture in event of bad fault.

Dependable service through the years because there are no moving parts to stick or get out of order.

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

Blowing time charts and more information are available on FUSETRON Fuses and BUSS Hi-Cap fuses. Write for bulletin FIS and HCS.

BUSSMANN MFG. CO., (Division of McGraw Electric Company) University at Jefferson, St. Louis 7, Mo.

Fuses throughout the entire Electrical System!

Morgan Modernizes Shop Facilities

▲ A new large continuous welder, now at work for the Morgan Engineering Co., Alliance, Ohio, reduces costs and the time of welding girder seams as much as 94 per cent. The welder which has a track length of 110 ft can move at speeds up to 120 in. per min. The unit has two welding heads that float along the ram horizontally and vertically up to 3 in. For vertical movements more than 3 in., the arm must be inched up or down. The welding heads will trace curves and follow a change in direction around a girder flange, allowing two seams of a girder to be welded at one time. The welder can also accomplish the welding of both girth seams of hoisting drums at one time. Morgan uses Hobart constant voltage motor-generators, rated 900 amp, 20-40 volt, to give complete operation control. Motors are rated 60 hp.

The welder was developed by the Morton Manufacturing Co. of Muskegon, Mich., for Morgan. It enables Morgan to eliminate variables found in manual welding operations and increases the strength of welds by using the submerged-arc method to give complete penetration.

The installation of the 110-ft traveling welder was a major step forward in an extensive capital modernization program in which more than $1,500,000 has already been invested.

The five-year program will give Morgan one of the most complete and flexible heavy manufacturing plants in the country, consisting of 500,000 sq ft of plant area housing its structural, weld, pattern, erection, forge, and machine shops. Morgan can now fabricate structurals and weldments up to 200,000 lb. It has machining facilities for equipment of all sizes and shapes, accommodating sizes and shapes up to 200 in. × 21 ft × 9 ft high and 144 in. × 30 ft × 10 ft high. The erection floor (600 × 100 ft) with crane capacities up to 100 tons can handle the heaviest of assemblies.

Figure 1 — This large continuous welder, designed and developed by the Morton Manufacturing Co. and the Morgan Engineering Co., has a track length of 110 ft. It can obtain speeds up to 120 in. per min and reduces the cost and time of welding girder seams as much as 94 per cent.

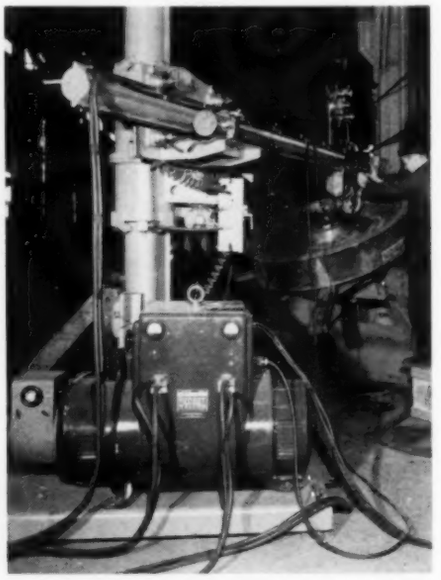
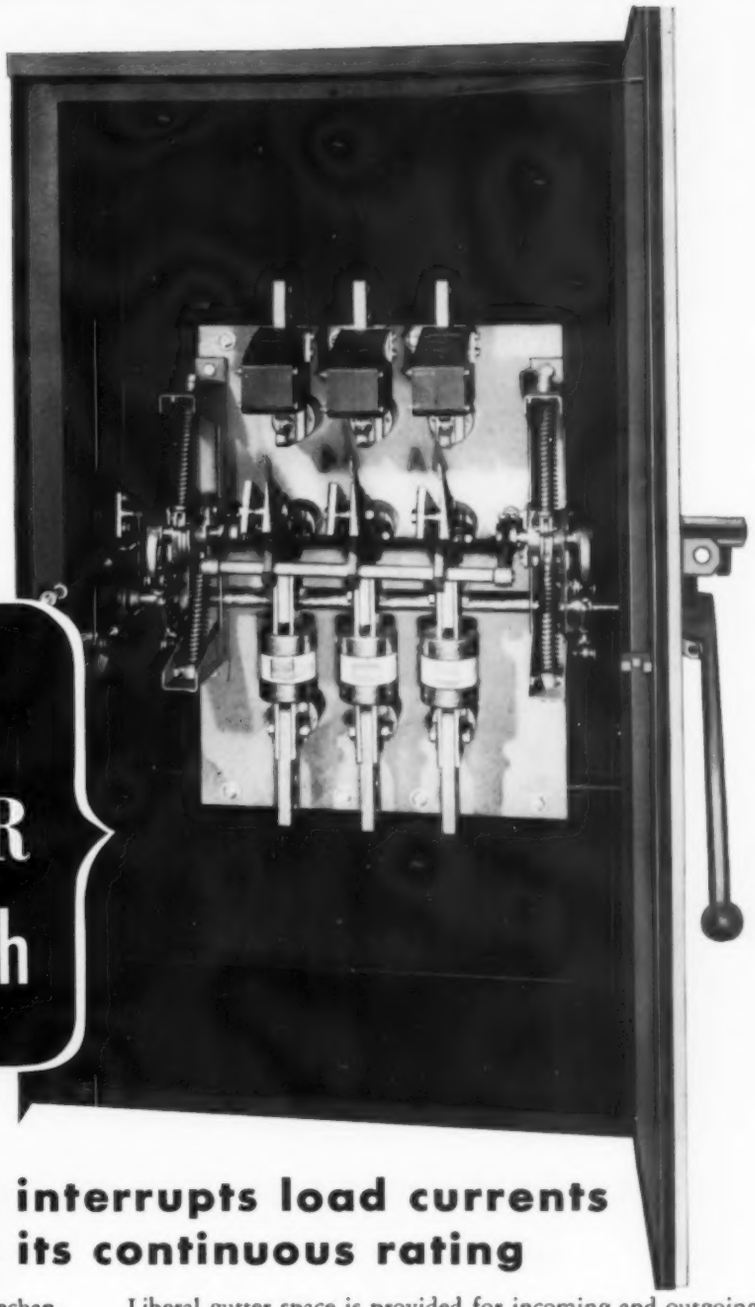


Figure 2 — This automatic gear welder is another unit in the modernization program.

Another DELTA-STAR Safeguard for Steel Mills

These rugged disrupter switches meet a long-felt need for a switch to safely interrupt heavy load currents. Combining the function of a disconnect and load interrupter, they are ideally suited for opening large motor circuits or for branch feeder control.

Illustrated is a 600-volt, 1200 ampere DELTA-STAR Disrupter Switch with current limiting fuses.



New 600-Volt DELTA-STAR Disrupter Switch

safely, positively interrupts load currents several times its continuous rating

These switches feature a quick-break, quick-make mechanism which places opening or closing speeds beyond the operator's control. DELTA-STAR'S exclusive arc interrupting chambers, one mounted on each pole, quickly and positively extinguish the arc.

An auxiliary contact on each switch blade opens circuit inside the especially designed arc chute. The arc is broken and cooled by being directed into vents — contacts are protected against burning and pitting.

Heavy gauge steel cabinets provide maximum protection of operating parts. Continuous welded seams and weathertight gasketed doors exclude dust and corrosive particles. Liberal gutter space is provided for incoming and outgoing conductors.

Cabinet door is mechanically interlocked so door cannot be opened when switch is closed, nor can switch be operated when door is open. Provision for padlock eliminates unauthorized operation.

DELTA-STAR Disrupter Switches are available in continuous current ratings of 400, 600, 1200, 2000 and 3000 amperes. To protect the electrical system from magnetic or thermal destruction, switches are also available with high interrupting current limiting fuses which prevent development of peak short circuit currents.

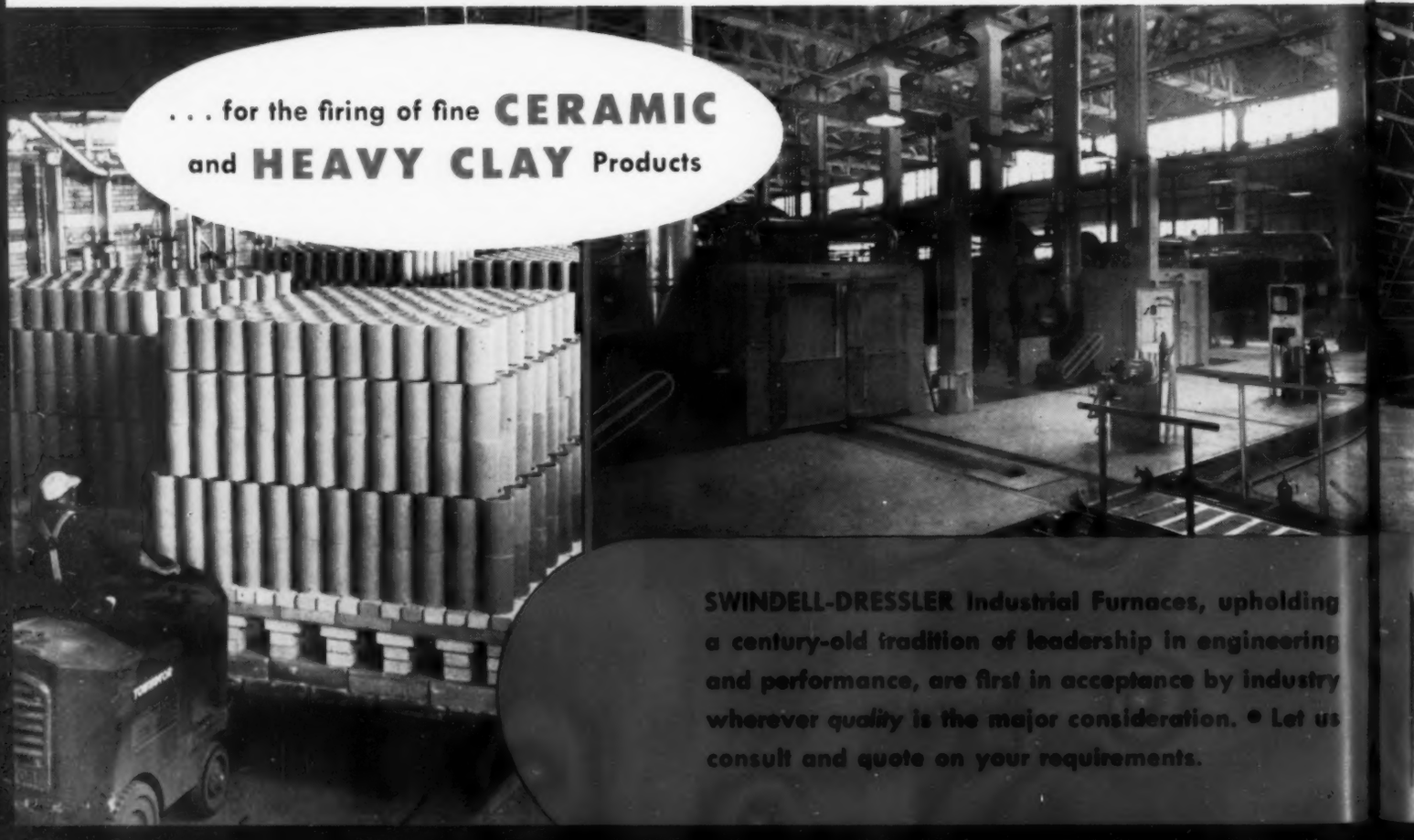
For complete data, consult your nearby DELTA-STAR *representative.*

DELTA-STAR ELECTRIC DIVISION

H. K. PORTER COMPANY, INC.
OF PITTSBURGH
2437 Fulton Street • Chicago 12, Illinois
District Offices in Principal Cities

SWINDELL-DRESSLER

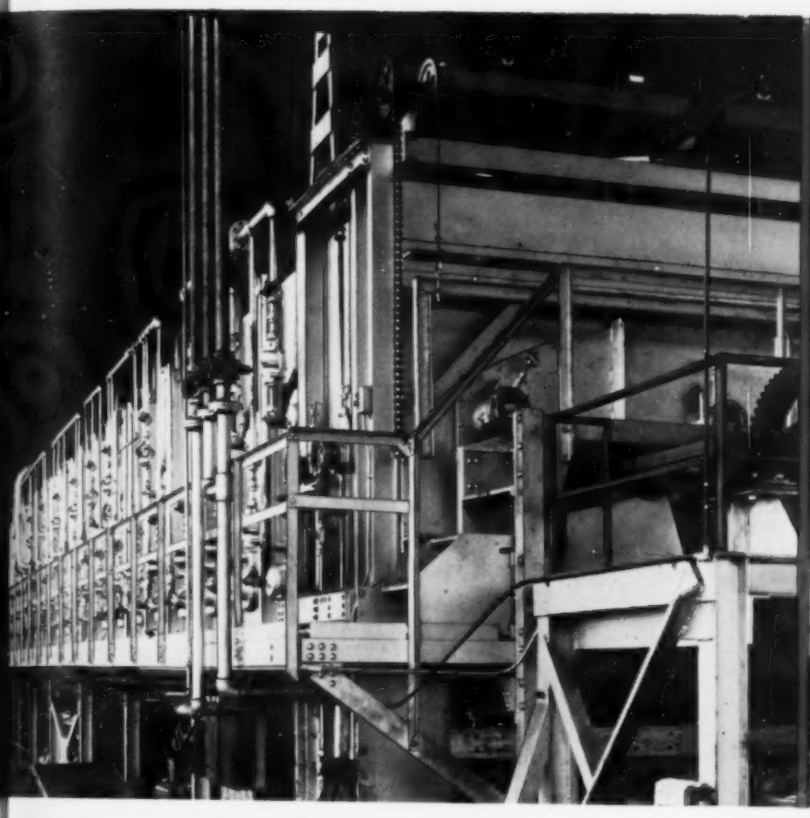
. . . for the making, annealing and heat-treating of **STEEL**

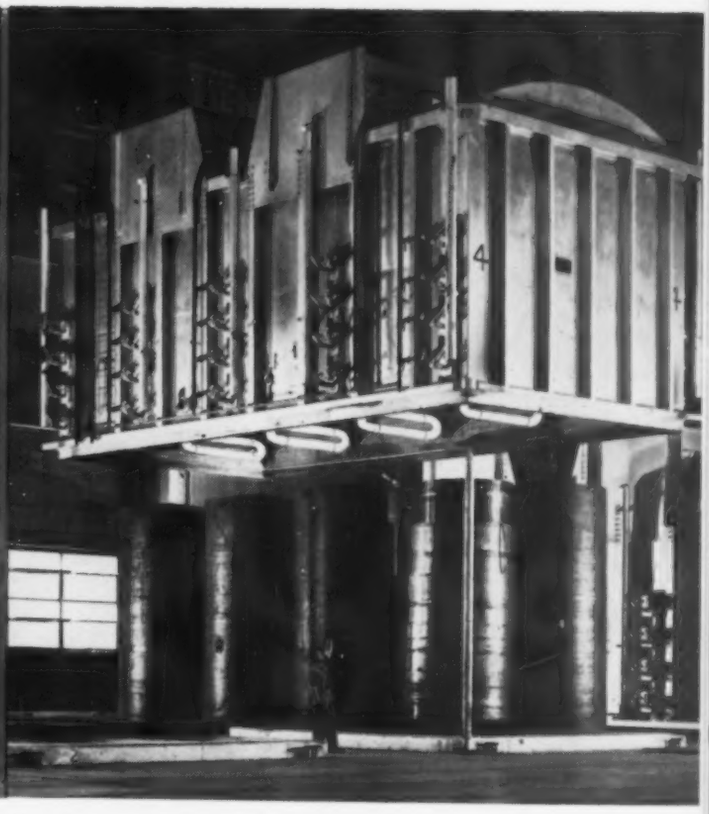


. . . for the firing of fine **CERAMIC** and **HEAVY CLAY** Products

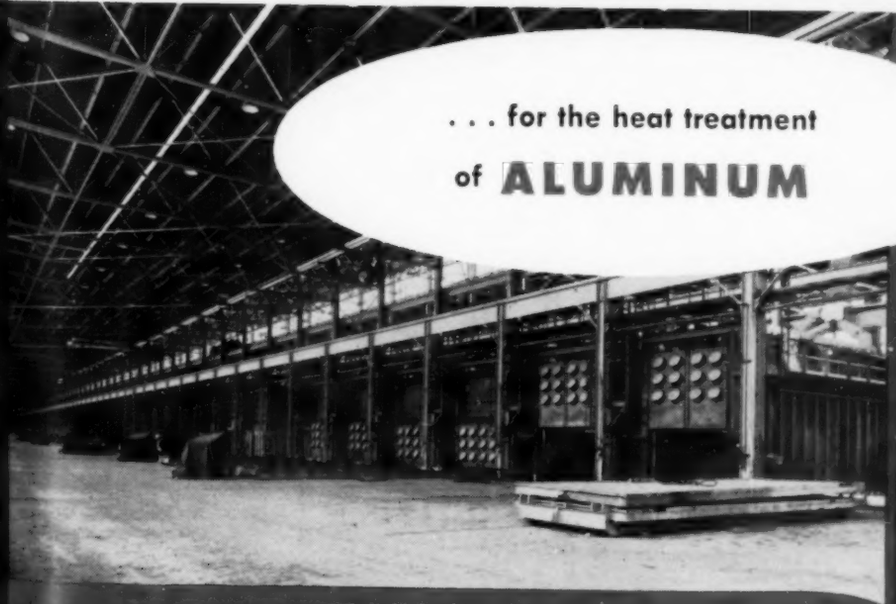
SWINDELL-DRESSLER Industrial Furnaces, upholding a century-old tradition of leadership in engineering and performance, are first in acceptance by industry wherever *quality* is the major consideration. • Let us consult and quote on your requirements.

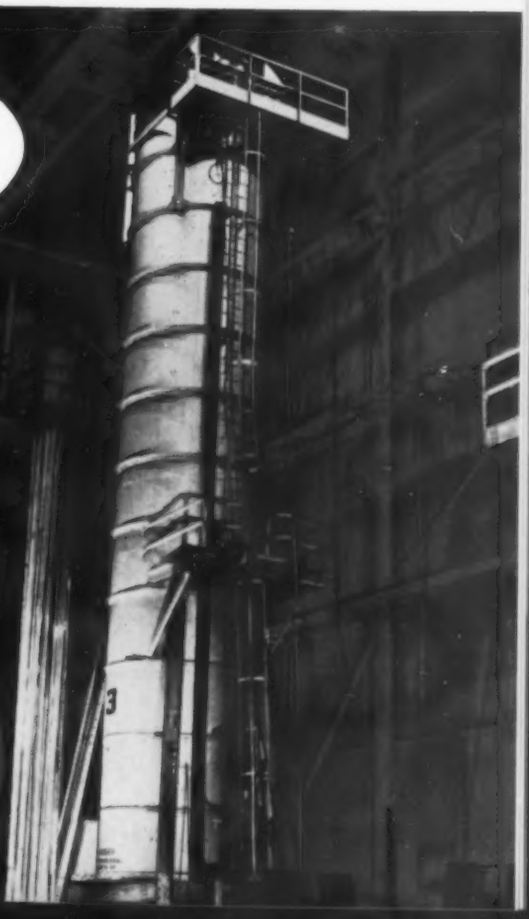
Modern INDUSTRIAL FURNACES





. . . for the heat treatment
of **ALUMINUM**

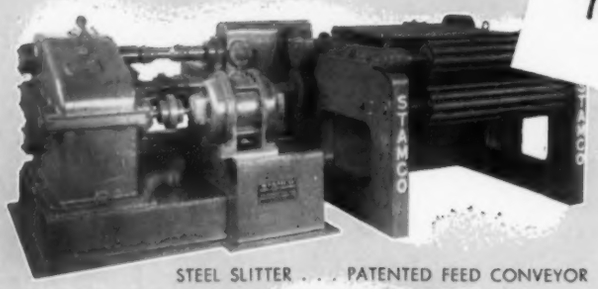




SWINDELL-DRESSLER
Corporation
Designers and Builders of Modern Industrial Furnaces
PITTSBURGH 30, PA.

For Special Operations in Steel Mills...

PAY-OFF OR UNWIND REEL

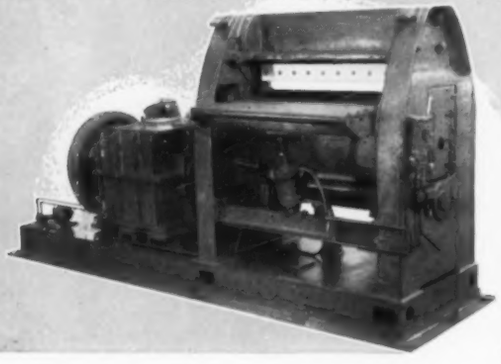


STEEL SLITTER . . . . PATENTED FEED CONVEYOR

—call or write

Stamco

for the equipment you need



UP-CUT SHEAR

REWIND REEL

Available in a wide range of sizes and speeds for warehouse and mill duty on ferrous and non-ferrous materials. Tell us your needs and we'll give you complete details.

No obligation.

SHEET RESQUARING UNIT

STAMCO, Inc., New Bremen, Ohio

CRANE VALVES have longest life in this sulphur pit

THE CASE HISTORY— Leakage in steam lines to sulphur pit heating coils was hindering operations at International Minerals & Chemical Corp. plant at Lockland, Ohio. The condition prevented servicing of traps, strainers and the heating coils.

Valves that leaked beyond repair after as little as 6 months' service were the source of the trouble. Their seating as well as packing failed to stand up.

In January, 1953, after trying other types, Crane 14½P Plug Type Disc Globe Valves were installed. Today, they're still giving excellent service at low cost. Recently, the steam piping was completely replaced—the Crane valves were repacked and put back in the lines. That's all the maintenance they needed after 18 months in this severe service.

Crane 150-Pound No. 14½P Plug Type Disc Brass Valves

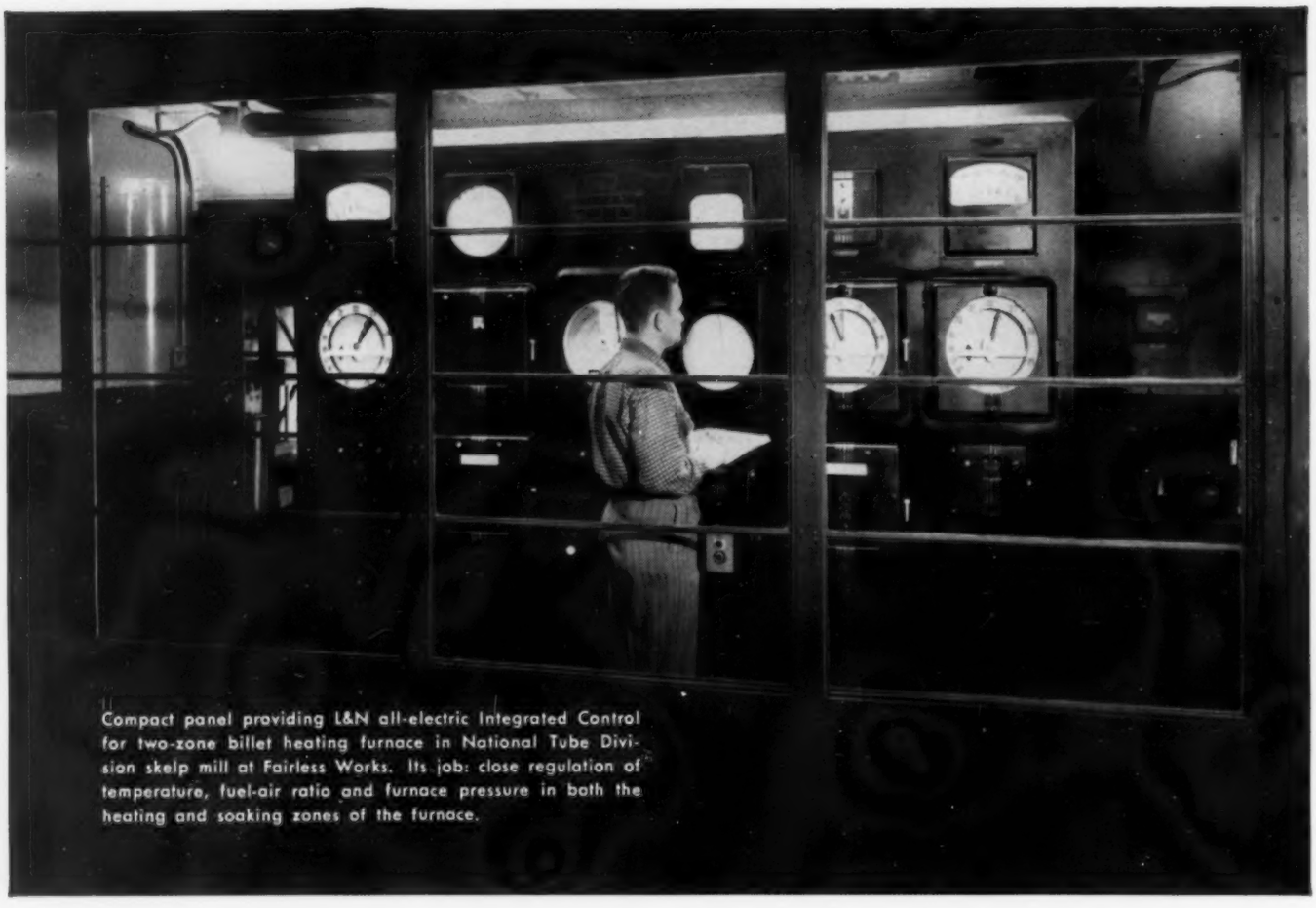
Long-wearing, hard seating surfaces in a rugged, well-proportioned, Crane-designed body make these valves exceptionally suited for steam and other severe services. Consult your Crane Catalog or your Crane Representative.

CRANE CO.

General Offices: 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

CRANE'S FIRST CENTURY . . . 1855-1955



Compact panel providing L&N all-electric Integrated Control for two-zone billet heating furnace in National Tube Division skelp mill at Fairless Works. Its job: close regulation of temperature, fuel-air ratio and furnace pressure in both the heating and soaking zones of the furnace.

NATIONAL TUBE REGULATES BILLET FURNACE WITH

L+N Integrated Control

● All Leeds & Northrup Integrated Control panels are factory-engineered for the specific job . . . yet employ standardized instruments recognized for their simplicity, accuracy and flexibility.

For example, the controllers which are keeping tab on temperature, on fuel-air ratio and on gas pressure at this National Tube furnace all use the same stable, sensitive proportional controlling action. Result: close adjustment for optimum control with proportional band, automatic reset and rate action readily tuned by the operator to suit the individual furnace characteristics.

All L&N electric control units rely—for sensitivity in control detection and accuracy in control correction—on the well-established principle of the null-balance measuring circuit.

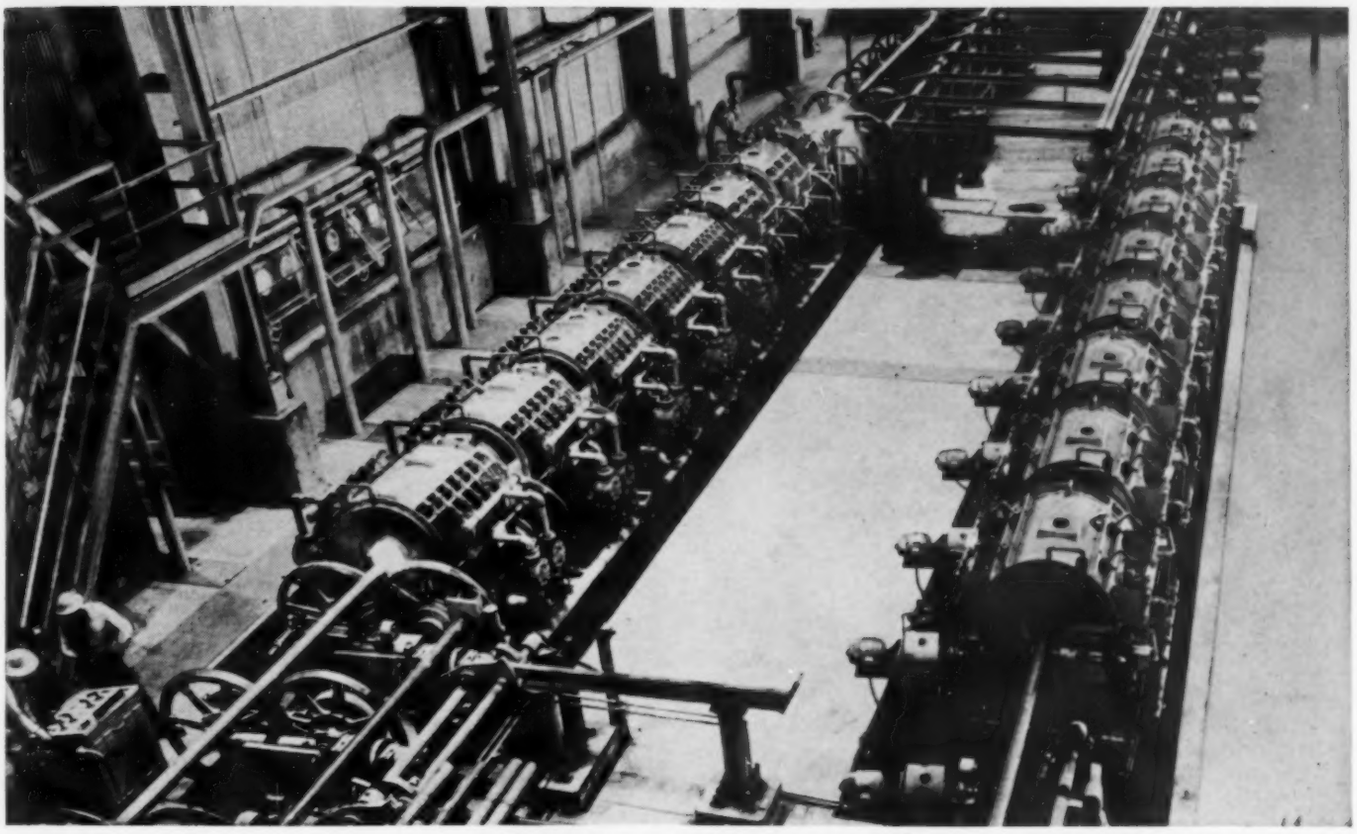
L&N integrated control instruments are easy to adjust . . . easy to maintain. They can be mounted on a panel to suit your individual requirements. Installation at your plant site is carried out quickly and economically.

End result, of course, is a furnace control system which steps up operating efficiency . . . provides better heating of the work . . . economizes on fuel . . . and cuts maintenance costs.

This same combination of L&N instruments and specialized engineering service is available for the solution of your furnace control problems. Just contact your nearest Leeds & Northrup representative about Integrated Control or, if you prefer, write us at 4942 Stenton Ave., Philadelphia 44, Pa., outlining your problem.

LEEDS *instruments* **NORTHRUP** *automatic controls • furnaces*

PIPE TREATED ON NON-STOP BASIS

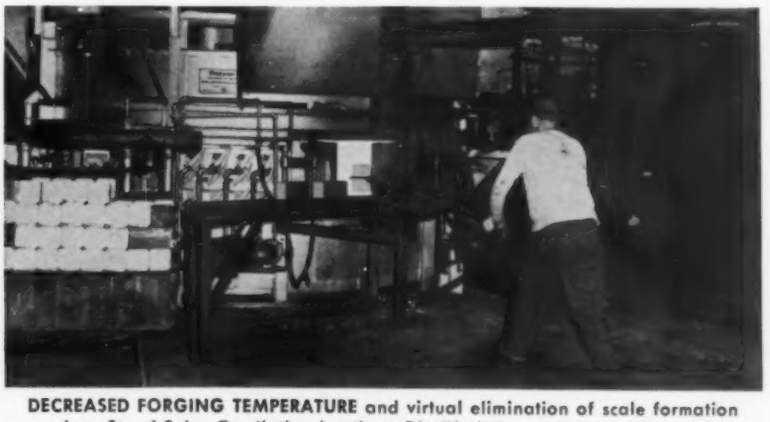


IMPROVED PHYSICAL PROPERTIES, and significant savings in alloying elements are obtained when seamless steel pipe is uniformly hardened and tempered in this continuous, completely automatic line of gas-fired Gradiation furnaces . . . pipe is straight and scale-free. *Photo courtesy Colorado Fuel and Iron Company.*

SELAS
HEAT PROCESSING
AT WORK

● Selas Gradiation heating is the key to improved efficiency wherever you use heat for processing. In *heat treating, brazing, forging, strip annealing,* and other continuous operations involving both ferrous and nonferrous metals, Selas Engineers can design heat processing equipment to help speed production, improve product quality and reduce manufacturing costs. *Write for descriptive data.*

CONTROLLED HARDNESS PATTERN is achieved in flame surface hardening of gears, segments, cylinders, using Selas heat processing. *Photo courtesy Wiedemann Machine Co.*



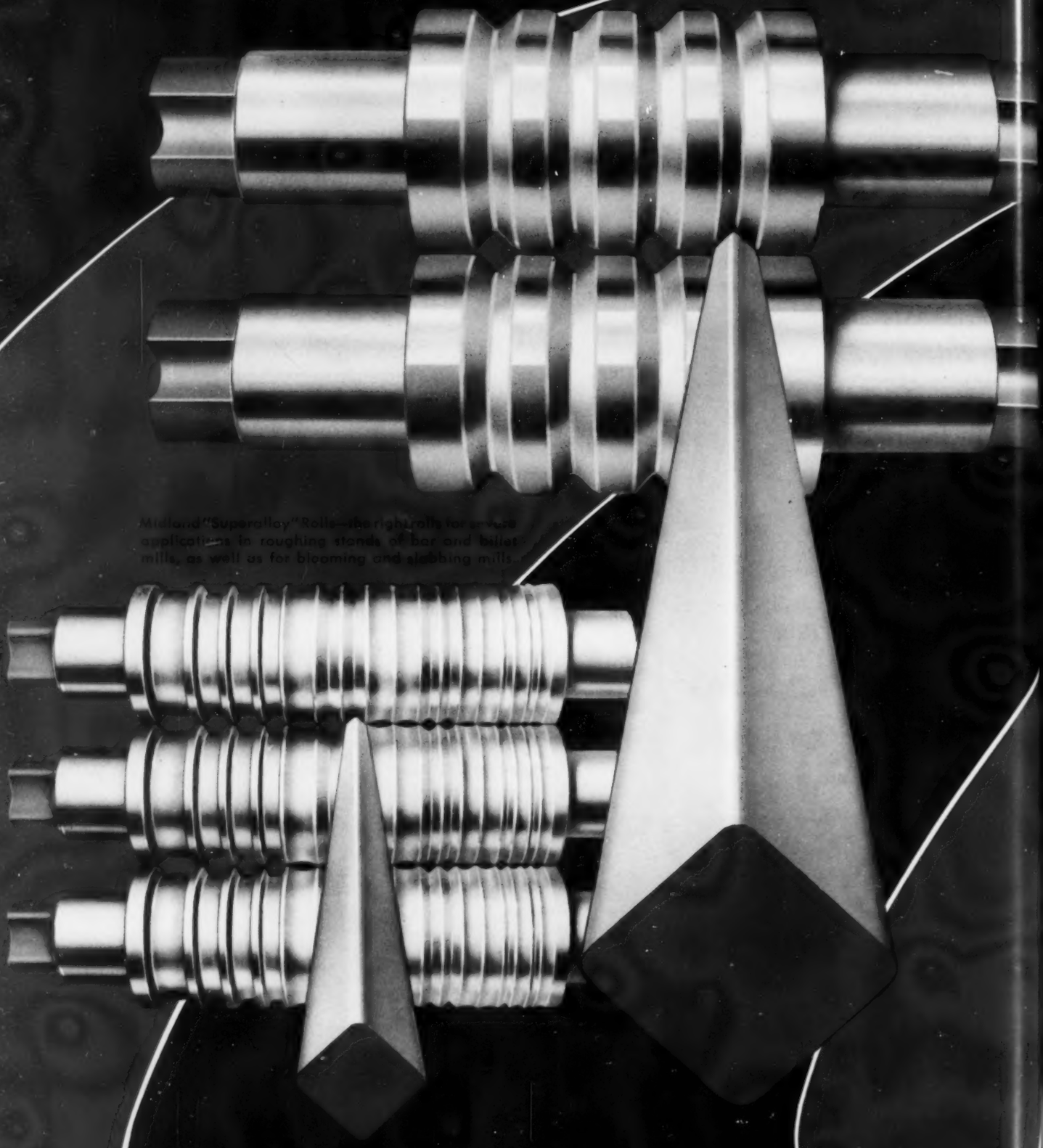
DECREASED FORGING TEMPERATURE and virtual elimination of scale formation are benefits of Selas Gradiation heating. Die life is increased . . . billet weight reduced 10%. *Photo courtesy Lansdowne Steel and Iron Company.*

SELAS

SELAS

CORPORATION OF AMERICA
PHILADELPHIA 34, PA.

Midland "Supermetal" Rolls—high carbon alloy rolls for maximum tonnage production in the intermediate stands where deep penetration of controlled roll hardness is essential to good finish.



Midland "Superalloy" Rolls—the right rolls for severe applications in roughing stands of bar and billet mills, as well as for blooming and slabbing mills.

MACKINTOSH-HEMPHILL PRODUCTS INCLUDE: all types of cast mill rolls . . . improved Johnston patented corrugated cinder pots and slag handling equipment . . . Mackintosh-Hemphill rotary straighteners . . . electronically controlled contouring lathes . . . screw feed roll turning lathes . . . heavy duty engine lathes . . . shears . . . end-thrust bearings . . . steel and special alloy castings . . . reversing hot strip mills . . . Y-type cold strip mills.

Right

for every stand of every billet and bar mill...

MACK-HEMP STRIPED RED WABBLER ROLLS

M-H "Nironite C" Rolls—indefinite chilled nickel iron alloy—withstand wear as well as impart a high finish, assuring top performance in the finishing stands of continuous bar and billet mills.

MACKINTOSH HEMPHILL COMPANY

Makers of the rolls with the striped red wabblers

PITTSBURGH AND MIDLAND, PA.

High speed, high tonnage operation of Billet and Bar Mills, with its significant influence on production costs calls for extra discrimination in the selection of rolls.

Bar mill operators know that the solution of manufacturing cost and quality problems depends to a large degree on the rolls and the roll maker's ability to satisfy their exacting demands.

Many years of roll making experience combined with a policy of close cooperation with mill operators and roll designers equip Mack-Hemp to produce rolls that set a record production pace in today's efficient mills.

That's why so many steel producers will tell you that now, more than ever, it pays to keep an eye on what's new and different at Mack-Hemp.

WASTE HEAT BOILER CLEANED BY DOWELL IN 13 HOURS

Inspection after chemical cleaning showed boiler free of scale—danger of burning tubes minimized

The water side of a waste heat boiler had become fouled with scale. Cleaning of the unit was necessary to avoid the risk of burning the tubes. Dowell was called to do the job.

In just 13 hours, Dowell engineers cleaned the 6,000-gallon capacity boiler, using chemical solvents. The unit was found to be metal-clean upon inspection after the job was completed—thus the risk of burning the tubes was reduced to a minimum.

Many types of boilers, heat exchange and process equipment have been cleaned by Dowell's chemical methods . . . *without dismantling and with a minimum of downtime.* This service has saved thousands of man-hours and helped to prevent costly repairs and replacements.

Perhaps chemical cleaning could improve the efficiency of equipment in your plant. Dowell engineers do the job for you. They bring specially prepared solvents in truck-mounted tanks right to the job, along with all necessary pumping and control equipment. They apply the liquid solvents according to the technique demanded by the job: filling, spraying, jetting, cascading or vaporizing. The chemicals go wherever steam and water flow, reaching surfaces inaccessible to other methods. Often equipment may be cleaned while in operation.

A Dowell engineer will be happy to discuss your cleaning problems with you—make estimates, if you wish—no obligation, of course. For more facts about Dowell Service, call the nearest of more than 130 offices, or write directly to Department C-29, DOWELL INCORPORATED, TULSA 1, OKLAHOMA.

chemical cleaning service for industry

DOWELL

A SERVICE SUBSIDIARY OF THE DOW CHEMICAL COMPANY

Date-line Diary...

February 3

▲ Electricity output for the preceding week exceeded 10,000,000,000 kwhr for the first time, an increase of 13 per cent above the corresponding 1954 period.

▲ Canadian pig iron production in 1954 fell to 2,213,433 tons, 26 per cent under the 1953 figure.

▲ Allegheny Ludlum Steel Corp. announced total sales and revenues during 1954 totaled $170,056,405, with net earnings of $4,246,083 or $2.30 per share of common stock. (This is in sharp contrast to the $242,000,000 sales in 1953 with net earnings of $7,800,000 or $4.40 dividend per common share).

February 4

▲ Manufacturers' sales climbed to $24,900,000,000 in December, $500,000,000 above November and $1,000,000,000 above December 1953.

▲ Personal income ran at a $291,000,000,000 annual rate in December, $2,000,000,000 above the pace in November and $4,000,000,000 above the December 1953 pace.

▲ Koppers Co. reported total sales of $188,305,241 and a net income of $6,125,329 in 1954, equal to $2.77 a common share, a sharp decline from 1953's sales of $266,484,959 and net income of $9,025,981 or $4.51 a share.

▲ Federal Enameling and Stamping Co. of McKees Rocks, Pa. will spend over $250,000 in expansion to boost its aluminum kitchenware production.

▲ Jones and Laughlin granted a contract for the installation of a galvanizing unit at its Pittsburgh works.

February 5

▲ Sharon Steel Corp. announced its net income for 1954 totaled $3,134,864 equivalent to $2.85 per share on common stock, a drop from 1953's net income of $6,709,625 or $6.10 per share on common stock.

▲ The F. W. Dodge Corp. reports contract awards for the 37 states east of the Rockies set an all-time high in January with a total of $1,504,450,000, 31 per cent above January, 1954.

February 7

▲ Colorado Fuel and Iron Corp. announced the sale of $5,000,000 in debentures which were placed privately with a group of institutional investors.

▲ The Government placed a ban on refined copper exports in February and March and set a limit of 12,000 tons on shipments abroad of copper scrap during these same months. A severe strike at Rhodesian copper mines has resulted in a price jump of 5¢ per lb in London.

▲ The AISI reports that operating rate of the steel industry for the week of February 7 is scheduled at 87.4 per cent of capacity. This is equivalent to 2,110,000 tons compared with 2,070,000 tons one week ago and 1,774,000 tons one year ago. Index of production for the week is 131.4.

▲ Acme Steel Co. reports sales for 1954 at $71,799,884 with net earnings after taxes of $3,689,022 or $1.86 per share, compared with the previous year's sales of $76,992,558 and $3.35 per share.

February 8

▲ Pittsburgh Coke and Chemical Co. earned 39¢ per share in the fourth quarter of 1954 which brought the total earnings for 1954 to 71¢.

▲ Sale of the Mackintosh-Hemphill Co., with approximately $8,000,000 in assets, to the E. W. Bliss Co. was approved by the Board of Directors.

February 9

▲ Lukens Steel Co. will move into areas including the manufacture and marketing of end products in its search for diversification and more markets. It will also enter foreign markets.

▲ Canadian steel ingot production showed a 15 per cent gain in January with a total of 311,007 tons compared to December's 269,102 tons. This is up 7 per cent from the 290,487 tons in January 1954.

▲ January construction outlays amounted to $2,800,000,000, 13 per cent above January 1954 and 8 per cent below December.

▲ Major railroads in December declared their net income increased to $119,000,000 from $69,000,000 in December 1953 as a result of a 10 per cent cut in expenses.

▲ The Aluminum Association reported production of primary aluminum in December 1954 totaling 254,112,883 lb compared with 242,503,923 lb in November and 220,582,988 lb in December 1953.

February 10

▲ According to the AISI, steelmaking furnaces poured 8,838,000 net tons of ingots and steel for castings during January, the highest production since October 1953, about 551,000 tons above December production and 886,500 tons higher than in January one year ago.

▲ A 25 per cent tax credit would be granted U. S. citizens on dividends from Japanese companies under a proposed treaty approved by the Senate Foreign Relations Committee. The feature is to relieve Americans from paying taxes on incomes, gifts and inheritance which were already taxed in Japan.

February 11

▲ President Eisenhower's planned program to expand world trade was approved by the House Ways and Means Committee by a vote of 20 to 5.

▲ Barium Steel Corp. announced results of operations for 1954 with net sales amounting to $51,840,000, resulting in a net loss of $460,000 or 15¢ per common share, compared to 1953's net sales of $89,719,175 and net profit of $2,321,140, or $1.01 per common share.

February 13

▲ Consumption of ferrous scrap during December totaled 5,078,000 gross tons in comparison with 4,928,850 gross tons during the previous month.

February 14

▲ Auto production last week rose to 167,332 cars, an increase of 58,492 over one year ago and 2332

above the previous high in the third week of June 1950. Output is expected to remain steady until late March. New car sales in January climbed to 512,000 units, 44 per cent over January 1954.

▲ The AISI reports that operating rate of the steel industry for the week of February 14 is scheduled at 88.2 per cent of capacity. This is equivalent to 2,129,000 tons compared with 2,095,000 tons one week ago and 1,779,000 tons one year ago. Index of production for the week is 132.5.

February 15

▲ Directors of Republic Steel Corp. voted a quarterly dividend of $1.25 per share payable April 15 to stockholders of record March 21, 1955. A 2 for 1 stock split was also proposed.

▲ National production of goods and services in the last quarter of 1954 recovered to an annual rate of $362,000,000,000 which was $6,500,000,000 above the pace in the preceding three months.

February 16

▲ The Interstate Commerce Commission examiner upheld piggyback rates charged by six Eastern railroads. The case now follows on to the full commission for its decision.

▲ Crucible Steel Co. reported net sales in 1954 of $160,622,000 with a net income of $3,705,952 or $2.83 a common share compared with sales in 1953 of $232,276,000 and net income of $5,109,802 or $4.54 a common share.

▲ The Aluminum Association reported primary aluminum production in the United States in January totaled 256,406,748 lb, compared with 254,069,331 lb produced in the previous month and 232,493,207 lb in January 1954.

February 17

▲ The ARCI reported orders for new freight cars rose to 5087 in January 1955 from 2685 in December of the previous year. Sales in January totaled 2008 cars, leaving a backlog of cars on order as of February 1 of 18,395 compared with 15,317 on January 1, 1955.

February 18

▲ No. 1 heavy melting grade steel scrap rose $1 a ton to $38 as a result of recent substantial increases in steelmaking.

February 20

▲ General Electric Co. announced net sales for 1954 amounting to $2,959,077,000, resulting in net earnings of $212,613,000 (an all-time high) or $2.46 per common share, compared with 1953's sales of $3,128,127,000 and net earnings of $165,728,000 or $1.92 per common share.

February 21

▲ The AISI reports that operating rate of the steel industry for the week of February 21 is scheduled at 89.2 per cent of capacity. This is equivalent to 2,153,000 tons compared with 2,150,000 tons one week ago and 1,756,000 tons one year ago. Index of production for the week is 134.0.

February 23

▲ Allis-Chalmers reported net sales of $492,948,963 in 1954 with a net profit of $26,130,430 ($7.20 per common share), compared with sales of $514,474,465 in 1953 with a net profit of $21,943,569 or $6.58 per common share.

▲ A proposal by army engineers to build an additional 1,700,000 kw of hydroelectric power capacity at Niagara Falls will receive a hearing at Buffalo. The plan will be used by whatever group Congress decides should complete this job.

February 24

▲ Westinghouse Electric Corp. announced net sales in 1954 totaling $1,631,045,000, with a net income of $84,594,000 equal to $5.06 a common share, compared with net sales in 1953 totaling $1,582,-047,000, with a net income of $74,322,000 equal to $4.53 a common share.

▲ Announcement was made by Wheeling Steel Corp. to call all of its outstanding 3½ per cent debentures for redemption on March 28 at 103.679 per cent of their principal amount. Holders of such debentures may convert them into Wheeling Steel common stock at a price of $45 per share.

February 25

▲ The AISC reported bookings of fabricated structural steel in January amounted to 239,285 tons, 22 per cent greater than the previous month and 61,525 tons above the corresponding month of the previous year. Shipments during January totaled 218,670 tons, down 2 per cent from December. Backlog of work ahead as of January 31 stands at 1,346,107 tons.

▲ On net sales of $68,047,224, E. W. Bliss Co. reported a net income of $3,297,793, equal to $4.01 per share, for 1954, in comparison with net sales of $64,783,523 and net income of $2,831,433 or $3.45 per share for 1953.

▲ Interlake Iron Corp. announced net sales and other revenues of $66,019,337 for 1954, with net profit of $3,143,699 or $1.61 a common share, in comparison with 1953's sales and revenues of $80,751,560 with net profit of $5,779,005 or $2.96 a common share.

February 27

▲ Inland Steel Co.'s earnings for 1954 showed a record net income of $41,287,152 or $7.92 a share, compared with $33,867,184 or $6.90 a share in 1953.

February 28

▲ Bethlehem Steel Corp.'s 1954 operations showed a net income of $132,837,154 or $13.18 a common share against $133,947,837 or $13.30 a share in 1953. Revenues in 1954 totaled $1,656,809,455 compared with $2,082,025,788 in 1953.

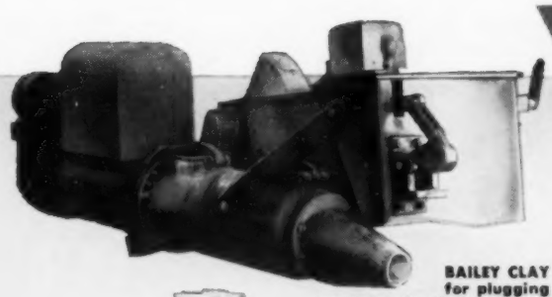
▲ Granite City Steel Co. showed net sales for 1954 totaling $69,265,197, with net income of $4,012,192 or $2.04 per common share, compared with sales for 1953 totaling $87,856,006 and net income of $6,488,452 or $3.77 per share.

▲ The Babcock and Wilcox Co. reported net income during 1954 of $15,212,000, equal to $9.78 per share, in comparison with a net income in 1953 totaling $12,061,000 or $8.14 per share.

▲ A Federal Court jury returned a verdict of $1,474,495 against Jones and Laughlin Steel Corp. resulting from a patent infringement suit against the steel company. The company was charged with infringement on an inventor's basic patents when it installed an electric tin plating line after consulting on the plans.

▲ Ore producers are expected to raise prices following the lead by Cleveland-Cliffs Iron Co. and Oliver Iron Mining Div. of U. S. Steel Corp., who raised iron ore prices 10 to 20 cents a ton.

▲ The AISI reports that operating rate of the steel industry for the week of February 28 is scheduled at 90.0 per cent of capacity. This is equivalent to 2,172,000 tons compared with 2,191,000 tons one week ago and 1,686,000 tons one year ago. Index of production for the week is 135.2.



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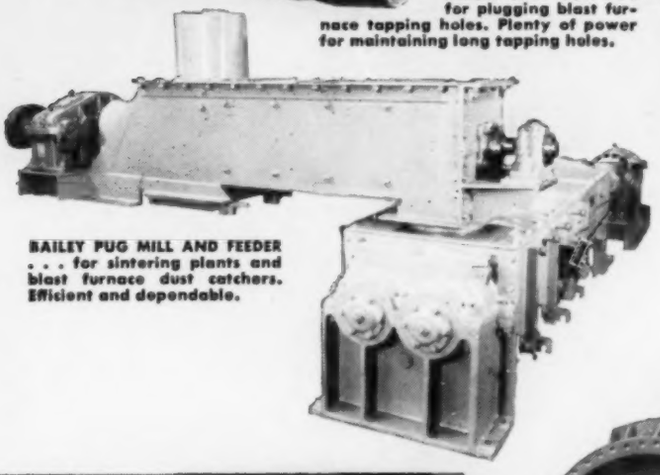

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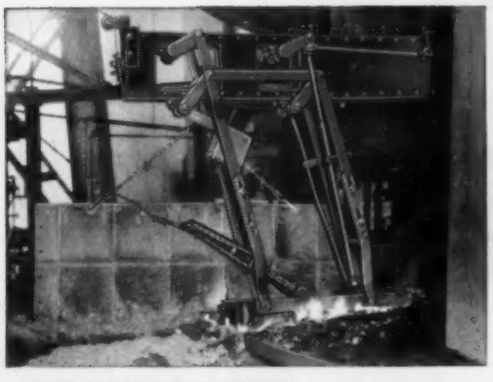

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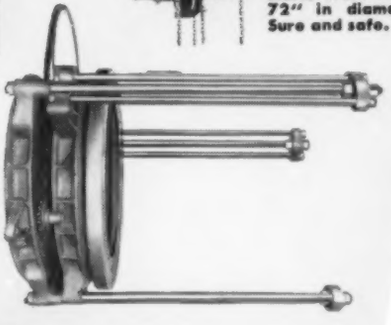

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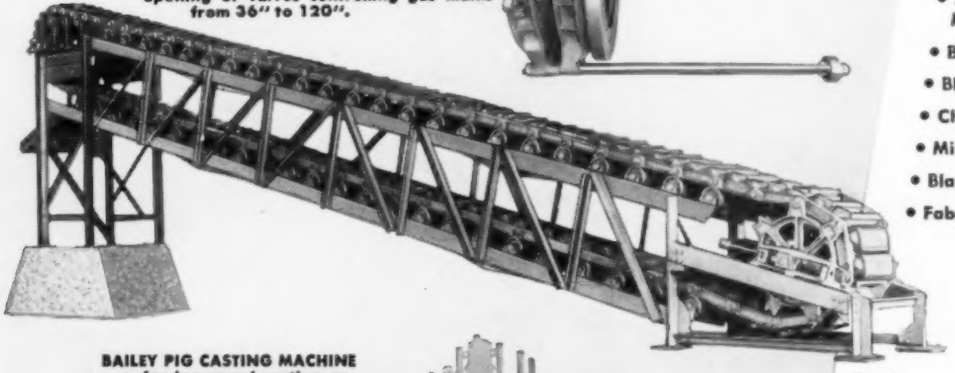

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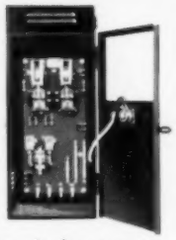
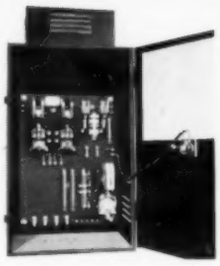
EC&M Magnet Controllers have earned a reputation for improved magnet operation. Loads are discharged quickly . . . cleanly . . . without "dribble". Magnets "work more" because faster drops eliminate "positioning" the magnet at point of discharge.

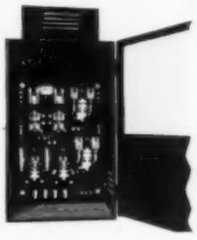
A simple two-position (lift-drop) Master Switch makes operation easy . . . power is off when the master switch is in the drop position. This prevents overheating, keeps lifting capacity high, and substantially adds to magnet life.



For single magnets or two magnets in parallel . . . Type AD STANDARD Controller has exclusive adjustable discharge feature for different type loads. (dial on door).



BOOSTER Controller gives increased pull-away power from pile, then carries load at reduced current.



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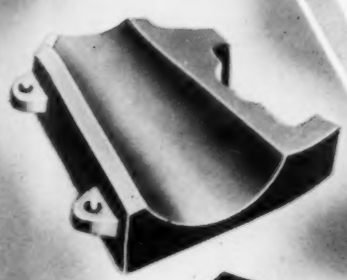

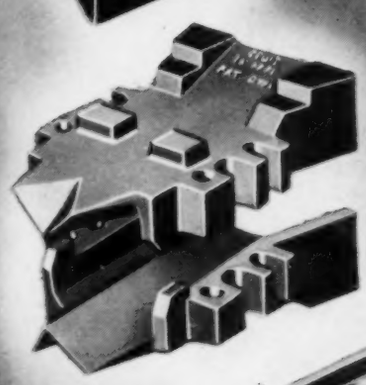

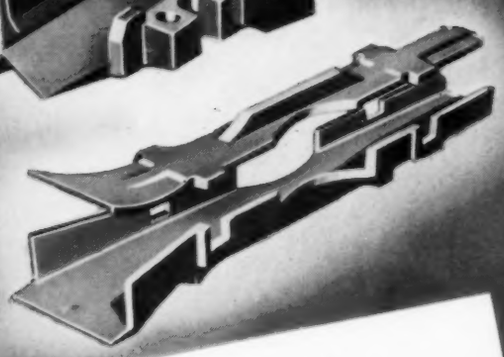

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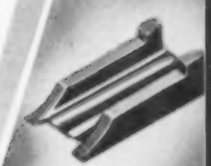

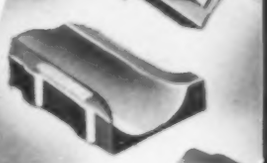

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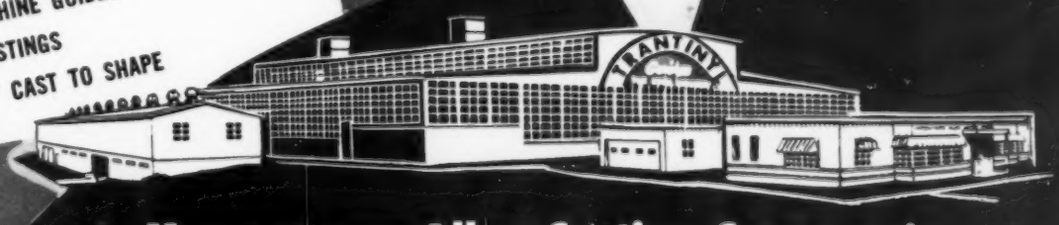

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Industry News...

BABCOCK & WILCOX PLANS CONSTRUCTION OF ATOMIC FUEL PLANT NEAR LYNCHBURG, VA.

▲ The Atomic Energy Division of the Babcock & Wilcox Co. announced plans for the construction of what is believed to be the first privately financed major plant for the manufacture of fuel elements and other reactor core components for the nuclear power industry. The plant, to be located about five miles east of Lynchburg, Va., is expected to be completed by the end of the year.

The proposed site of approximately 500 acres bordering the James River has been selected in accordance with regulations used by the Atomic Energy Commission in selection of government sites. Actual construction on the main building is expected to start shortly. It will be a one-story structure of approximately 100,000 sq ft, and will house various laboratories and offices as well as the complex manufacturing equipment.

B&W announced last year that it anticipates making complete nuclear steam generators for the production of electric power. The company has already developed and fabricated special equipment for many of the major atomic energy installations. The new plant will provide properly designed facilities for the manufacture of many types of special equipment for this rapidly growing industry.

Babcock & Wilcox has been active in the atomic energy field since 1942 and has contributed to both the defense and peacetime aspects of atomic energy development. The company designed and built vital equipment for the Nautilus, the world's first atomic submarine, and will also furnish much of the equipment used to power the second atomic sub, the USS Sea Wolf. In addition, B&W is supplying much equipment for large scale nuclear tests in the national laboratories and has developed and placed on the market three low-cost reactors which can be used by colleges and other organizations for research and training purposes.

During the last several years the company has been doing a considerable amount of developmental work, in association with various utilities and industrial concerns, investigating the feasibility of utilizing heat from nuclear fission to produce electric power.

INSTALLS LABORATORY AT SWISSVALE PLANT

▲ A new laboratory to offer advanced scientific services in agglomeration for the iron, steel and ore industries has been installed by Koppers Co., Inc. at the Swissvale, Pa. plant of the Engineering and Construction Division.

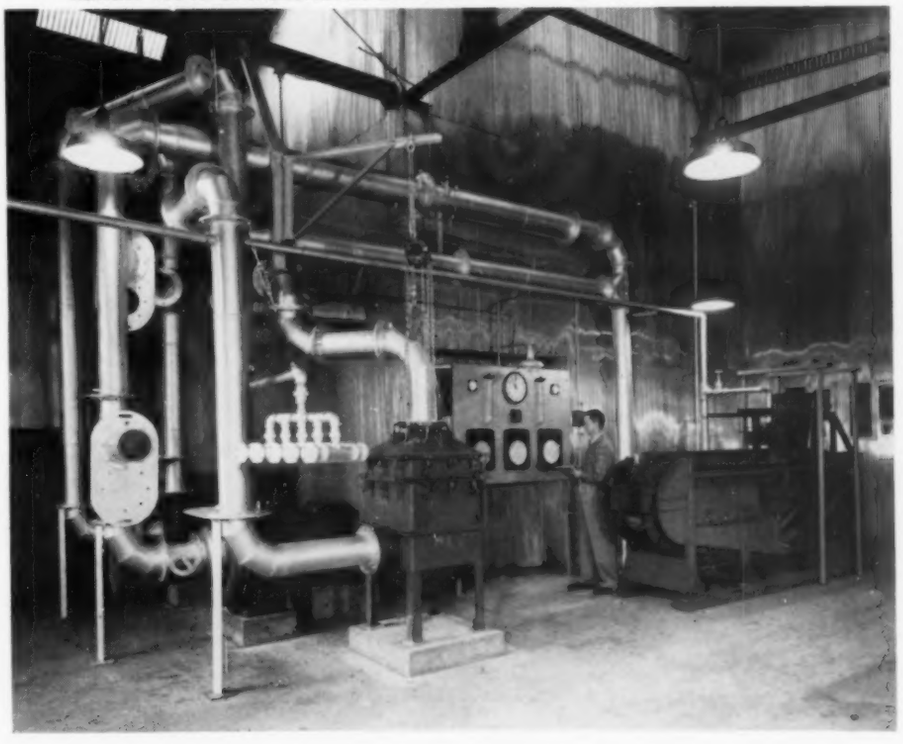
The new facilities will be utilized for customers in: (1) Investigations to determine the best process for making lump material from powder-fine ores and minerals and to determine agglomeration characteristics of untried ores and minerals; and (2) To determine operating and design conditions suited to the customer's needs for equipment required in agglomeration plants and to investigate the technical conditions of the several agglomeration processes.

The laboratory was built and will be operated by the development section of the Engineering and Construction Division. It will be under the technical supervision of the American Ore Reclamation Section of the Freyn department of the division.

The new laboratory is equipped with facilities needed to embrace all of the processes for producing particles of larger size and greater utility from fine ores and minerals including process equipment for sintering, pelletizing, nodulizing, briquetting, extruding, as well as equipment needed for the numerous variations of these processes for particular requirements of the customer.

Facilities are geared to handle 400 lb of material at a time, including 100 to 400 lb sintering pans, a small continuous sinter machine, recording instruments, and equipment for mixing, screening, crushing and grinding as well as for making physical tests on sinter.

Newly installed Laboratory facilities at the Swissvale, Pa. plant of Koppers Co., Inc. offers advanced agglomeration services. Facilities are geared to handle 400 lb of material at a time.



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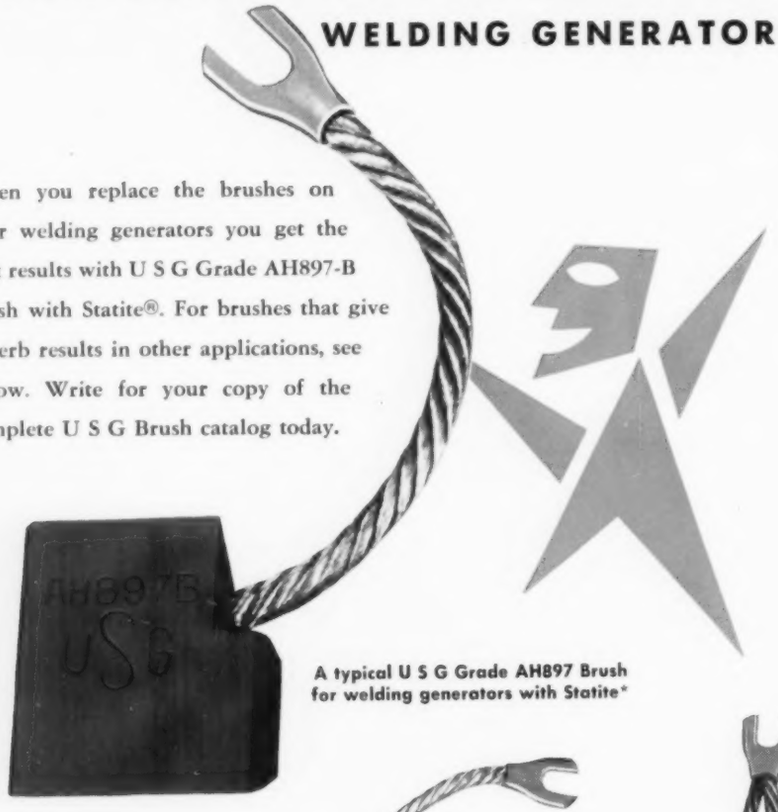

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U S G Grade 1658 Brush for tin line collector rolls

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U S G Grade 550 Brush for AC Crane Motor Rings

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*Permanent shunt connection, needing no hammerclips; cannot be jarred loose or pulled out.

THE UNITED STATES GRAPHITE COMPANY

DIVISION OF THE WICKES CORPORATION • SAGINAW, MICHIGAN

ORE FLEET TO OPEN SEASON ON APRIL 4

▲ The 59-ship fleet of Pittsburgh Steamship Division will proceed to Lake Superior to open the shipping season April 4, weather and ice conditions permitting, according to Donald C. Potts, president of this United States Steel Corp. division.

In announcing that the entire fleet would go into operation this year, Mr. Potts said there is every indication the 1955 shipping season will exceed that of 1954 in larger tonnages of raw materials to be transported on the Great Lakes.

PREDICTS STRONG SECOND QUARTER SALES INCREASE

▲ Present indications are that Allegheny Ludlum Steel Corp. sales in the second quarter of 1955 will be the best experienced by the company since end of the Korean War, E. J. Hanley, company president reported.

While he said that the order picture would indicate a continuation of the strong demand throughout the year, Mr. Hanley would make no predictions beyond the second quarter.

He said the production efficiency of the company should continue to improve throughout the year. He pointed out that a new tandem cold-rolling mill went into operation in September, 1954. "While that mill and its auxiliary pickle, anneal and normalizing facilities are still being broken in, they should give us more and better production every day for several months to come."

He also declared that major installations in the company's multi-million-dollar improvement program have been completed and that a major part of start-up and re-location expense is out of the way. He said the company expects to spend approximately $10,000,000 on plant improvements in 1955, but they will not cause serious production disruptions or unusual start-up expense.

ANNOUNCES AGREEMENT WITH DUTCH COMPANY

▲ Air Products, Inc., is now offering equipment for the purification of coke oven gas. It is expected that coke oven gas will be used in the

a *Heyl & Patterson* contribution to Improved Efficiency in the Modern World of Coal Handling

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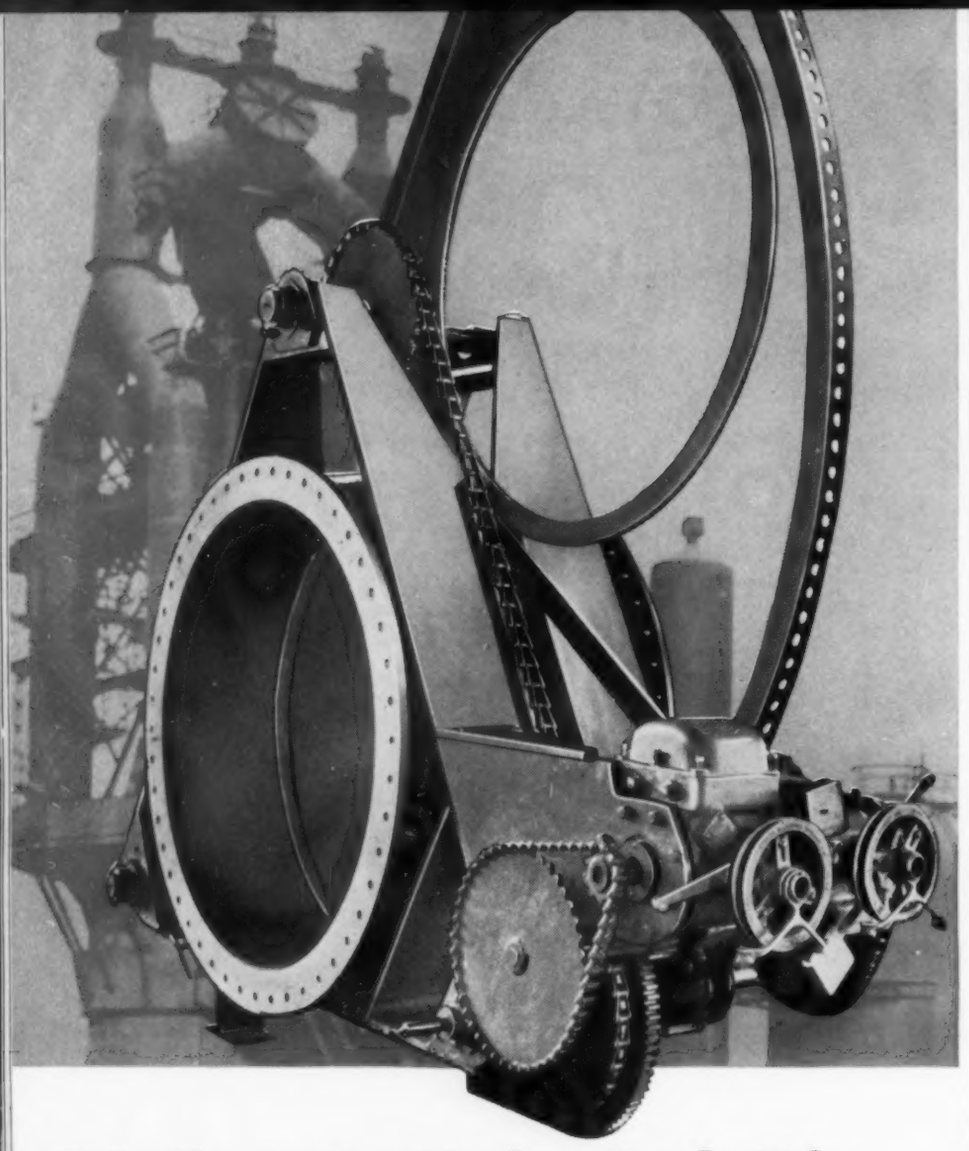

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Full Pipe Diameter Opening Through Valve
Heavy Plate Construction
Guaranteed Hot Line Service
No Service Connections
Positive High Pressure Equal Clamping and Sealing
Rapid Swinging, Counterbalanced Goggle Plate
Isolation of Valve Frame from Valve Body
Sealing Surfaces Isolated from Clamping Force
Adjustable Sealing Pressure Distribution
Non-Corrosive Seal Inserts in Valve Body
Plate Seat Rings of Optional Material
Plate Seat Rings Replaceable with Valve in Main
Operating Parts Replaceable with Valve in Main
Jackscrew Mechanism Sealed in Grease
Low Bearing Pressures in Jackscrews
Vertical or Horizontal Application
Optional Hand or Motorized Operation
Size Range from 36 to 108 In. Diameter
Adaptors Available for Valves Smaller Than Main

SALEM-BROSIUS, INC.

2400 East Carson Street, Pittsburgh 3, Pa.

In Canada: Salem Engineering Ltd. 1525 Bloor Street West, Toronto 9, Ontario

United States to produce ammonia synthesis gas, as has been the practice in Europe for many years.

The company has concluded an exclusive arrangement with Dutch State Mines of Holland for the use of all technical know-how concerning this process. The arrangement is reciprocal in that Air Products will exchange knowledge and experience in the low-temperature field.

Dutch State Mines is one of the principal manufacturers of ammonia synthesis gas from coke oven gas, and is prominent for its activities both in building and operating low-temperature processing equipment for this purpose.

MESTA REPORT LISTS HIGHER NET INCOME

▲ Mesta Machine Co., reports 1954 net income, after all charges and including provision for taxes, of $5,377,980, or $5.38 per share on the 1,000,000 issued shares of common stock. This compares with net income

REPUBLIC MILESTONE

Shown operating the controls of the 70-ton, top charge electric furnace that melted Republic Steel Corp.'s 150th million ton at the Canton, Ohio, plant is Charles A. Brauchler (right), president and general manager of Canton Drop Forging & Manufacturing Co., a Republic customer since the steel company was organized in 1930. The steel will be made into compressor wheels for jet aircraft. With Mr. Brauchler is Oscar A. Bamberger, manager of Republic Steel plants in Canton and Massillon.

of $3,500,416, or $3.50 per share in 1953, based on the same number of issued shares.

Unfilled business at December 31, 1954, amounted to $29,600,000 compared with $38,700,000 the previous year-end.

Lorenz Iversen, president, stated that while unfilled orders were lower than the previous year, "continual expansion and modernization program of the steel industry together with orders expected to materialize in the near future indicate that 1955 should be another year of satisfactory operations."

During 1954 the company's net current assets increased approximately $1,828,000 after payment of $2,963,974 in dividends and about $400,000 invested in improvements to plant and equipment.

Earned surplus at December 31, 1954 amounted to $21,821,434, compared with $19,407,428 the year earlier.

INSTALL NEW ANNEALING FACILITIES AT ALLENPORT

▲ New coil annealing facilities have been placed in operation at the Allenport Works of Pittsburgh Steel Co. to increase production of drawing quality cold rolled sheet steel.

Two portable coil annealing furnaces and five more bases have just been installed to complement the 12 furnaces and 31 bases completed last spring when the new cold rolled sheet mill first went into operation.

The new furnaces are very much like the existing facilities but have larger heat checks that provide larger Btu ratings and permit shorter heating times.

BOARD AUTHORIZES EXPANSION PROGRAM

▲ The board of directors of Washington Steel Corp. has authorized the expansion of the company's facilities for the production of stainless steel sheet and strip. The company plans the installation of a 48-in. sendzimir cold rolling mill, together with suitable collateral facilities, which will broaden its market.

It is expected the new facilities will cost approximately $2,600,000. A stockholder's meeting will shortly be called to take appropriate action on the Board's proposal.

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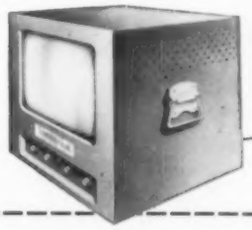

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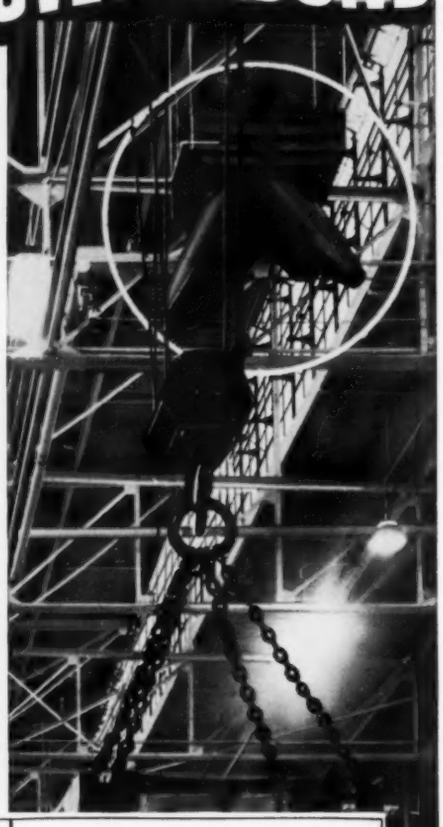
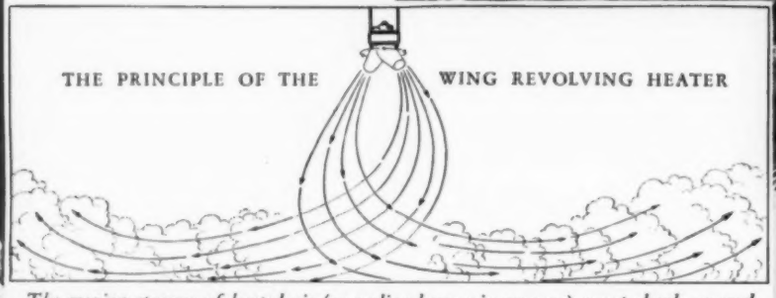
HEAT THAT MOVES AROUND

THE fact that the discharge outlets of WING Revolving Unit Heaters keep the heated air in constant, gentle motion is one of the reasons why nationally known firms like the Budd Company have installed them in their plants, both at Philadelphia and in the one shown in this photograph, at Gary, Indiana. The big blanking and forming presses in this great plant present a natural barrier to ordinary fixed discharge heating systems, but not to the moving streams of heated air from the WING Revolving Heaters, even suspended, as they must be, far above the floor, to clear the cranes. That is equally true in the summer time when, with steam turned off, the cooling breezes from the revolving discharge outlets keep workers comfortable on the hottest days. Investigate. Write for Bulletin HR-6A.

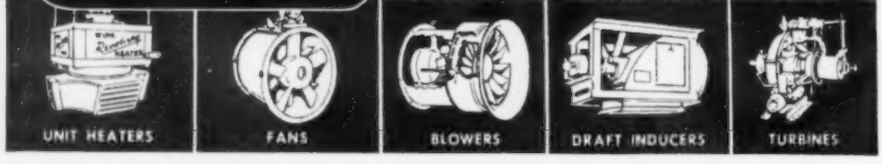




The moving streams of heated air (or cooling breezes in summer) sweep slowly around through 360 degrees, covering successively every direction. The air velocity is sufficient to carry to walls, and remote corners and the constantly changing direction of flow causes the air to find its way around obstructions.

Wing

L. J. Wing Mfg. Co.
142 Vreeland Mills Road
Linden, New Jersey
Factories: Linden, N. J. and Montreal, Can.
In Europe: Etab. WANSON, Brussels, Belgium



MARKET EXPANSION PLANNED BY LUKENS

▲ Launching a five-year expansion of its current markets, Lukens Steel Co. will intensify product development to include diversification outside the capital goods field, according to an announcement made to stockholders February 9 by President Charles Lukens Huston, Jr.

The company will thus manufacture and market end products and also enter markets foreign to the company's historical base.

In addition to modernization of facilities that will enable Lukens to capture an increasing share of the heavy industries requirements, Mr. Huston said the company was "carrying forward a two-pronged development program."

"We plan to develop new items for manufacture and sale in line with market needs. These are counted on to expand our basic product lines through the production of end products. Such activity is termed new product development.

"Second, and at the same time, we are investigating opportunities for business which may carry us into markets foreign to our historical base, but which offer opportunities for advantageous return on invested capital, for capital appreciation and for expanded sales."

ANNOUNCES PURCHASE OF UNION STEEL CO.

▲ Purchase of the plant and facilities of Union Steel Co. by Kaiser Steel Corp., was announced recently.

Union Steel is a major steel fabricating and erection firm in east Los Angeles, Calif. An important activity of the company is the manufacture of aircraft and missile components including special tooling required, and mobile launching trailers as well as stationary launching platforms for missiles.

The firm also fabricates plate and structural shapes, truck tanks and equipment, and specialty steel items. It carries through with the erection of steel structures such as buildings, bridges, towers and specialized construction.

The plant and organization will be operated as Kaiser Steel Corp.—Fabricating Division. In line with

Kaiser policy, the majority of the existing organization will be retained as Kaiser Steel employees. A. W. Lewis, former president and owner of Union Steel will serve in an advisory capacity.

RIVERSIDE FURNACE BLOWN IN BY WHEELING

▲ Wheeling Steel Corp.'s Riverside blast furnace at Benwood, W. Va. began producing pig iron February 23. All six of Wheeling Steel's blast furnaces are now in production to meet the demands of the company's steel output at Steubenville and Mingo Junction, Ohio.

A continuing high rate of production is anticipated at the company's tin and terne plate producing facilities at Yorkville, Ohio. This plant has been operating at near capacity for some time.

NEGOTIATES AGREEMENT WITH GERMAN COMPANY

▲ A cross-licensing agreement with Carl Schenk, Darmstadt, Germany, involving testing equipment, SR-4 strain gages, and SR-4 strain gage devices for both laboratory and industrial uses has been announced by Baldwin-Lima-Hamilton Corp.

Baldwin will manufacture and sell the extensive Schenk line of fatigue testing equipment, including shake tables, torsion fatigue and rotating bending fatigue testing machines for wire.

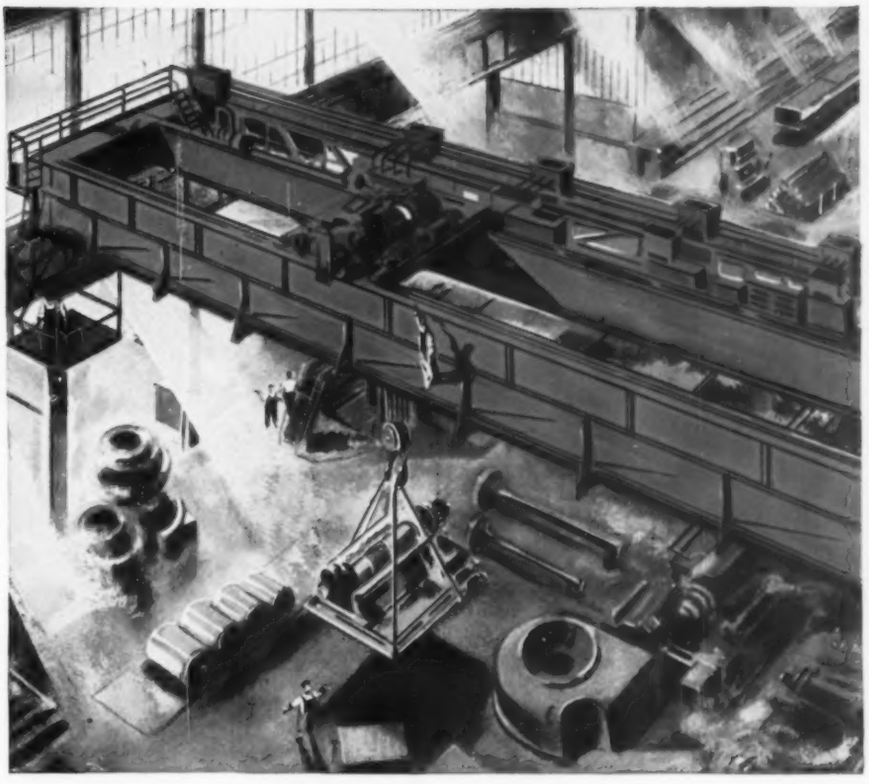
The right to manufacture and sell Baldwin SR-4 bonded resistance wire strain gages, SR-4 devices, testing machines, and associated instrumentation in Europe has been given in return to the German firm.

FIRM ESTABLISHES NEW OFFICE IN SALEM, OHIO

▲ A new Ohio Knife Co. office, established primarily to service the steel mill industry, has been opened in Salem, Ohio, under the supervision of W. Wentz Alspaugh.

EXPANSION PROGRAM ANNOUNCED BY CALSTRIP

▲ Investment by Calstrip Steel Corp. of Los Angeles, Calif. of more than half a million dollars in new equipment and plant facilities has been announced. This is the largest single



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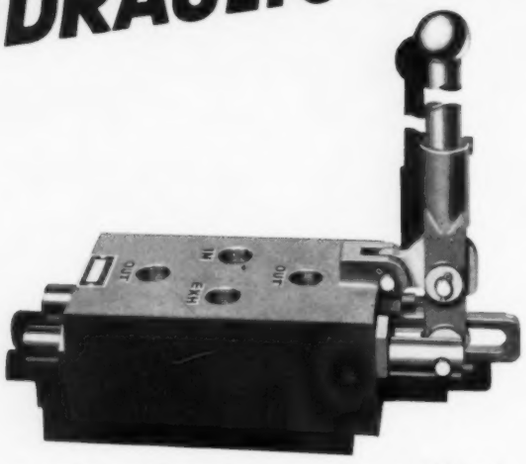
MORGAN ENGINEERING of ALLIANCE, OHIO

THE MORGAN ENGINEERING COMPANY, ALLIANCE, OHIO

Quick-As-Wink®
HYDRAULIC VALVES

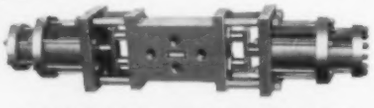


Hand Lever and Pilot Cylinder Types—pressures to 5000 psi.

Have won industry wide recognition for unsurpassed dependability

• Positive and fast acting, Quick-As-Wink Control Valves are designed and built to meet the most exacting requirements. Bodies of hydraulic valves are either forged or milled from solid bars. The hollow, radially ported, stainless steel plungers are chrome plated and polished to minimize wear. All parts are readily accessible and maintenance—that consists mostly of the very occasional replacement of the packing — can be done easily **in the field** without even disconnecting the piping. This avoids the necessity of returning valves to the factory for servicing or maintaining large standby inventories. Let us recommend the sizes and types that will meet your requirements best. Write for Bulletin 531. It gives full details.

Ask us also about . . .



DOUBLE PILOT CYLINDER HYDRAULIC VALVES operated with air or hydraulic pilot cylinders—3 position; neutral, compound-on or compound-exhaust.

DOUBLE SOLENOID "O-TYPE" VALVES for pressures up to 125 psi. Widely used as pilot valves and for operating air cylinders.

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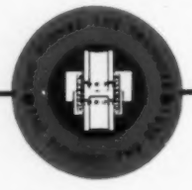

Hand, Foot, Cam, Pilot, Diaphragm and Solenoid Operated

Mfd. by C. B. HUNT & SON, INC., 1925 East Pershing St., Salem, Ohio

expansion program to be entered into by this producer since the founding of the company in 1939.

The expansion program consists of the installation of a sendzimir cold reduction mill, a roll grinder, a continuous annealing furnace, and new buildings.

Calstrip plans to have the new mill in operation by June, 1955.

YODER CO. SWITCHES EASTERN DISTRICT OFFICE

▲ The Eastern district office of the Yoder Co., was changed to the new Ridgeway Professional Building, Stamford, Conn.

R. H. Brinker, manager, and T. R. Bullen, representatives of the company have been located for the past several years in New York City. The move is being made to enlarge office facilities and to better service users of Yoder equipment in the Eastern area.

INSUL-MASTIC APPOINTS SWEDISH REPRESENTATIVE

▲ AB Hoganasarbeten of Stockholm, Sweden, contractors for acid and alkali proof constructions and sound conditioning installations, has been appointed to handle both the sales and application of Insul-Mastic Corp. coatings in Sweden, Norway, Finland and Denmark.

FORMS ORGANIZATION FOR COUPLING SALES

▲ Amerigear-Zurn, Inc. has been formed in Erie, Pa. as the national sales organization for the flexible couplings and allied power transmission products made by the American Flexible Coupling Co.

Future Meetings

▲ The American Zinc Institute's thirty-seventh annual meeting will be held at the Drake Hotel, Chicago, Ill., on April 28 and 29.

▲ The American Material Handling Society will hold a three-day conference in Chicago, Ill. on May 16, 17 and 18, during which the Sixth National Materials Handling Exposition will be presented. Both events will take place at the International Amphitheatre.

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HIGHEST QUALITY ELECTRIC FURNACE CARBON AND ALLOY STEEL CASTINGS

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"True Tooth" Gears and Pinions, Sheaves and Wheels.

CRANE WHEELS
Overhead, Gantry, Monorail, Ingot Car, Charging Machine.

STOKER PARTS
Feed Screws, Furnace Tools, Flanged Pipe, etc.

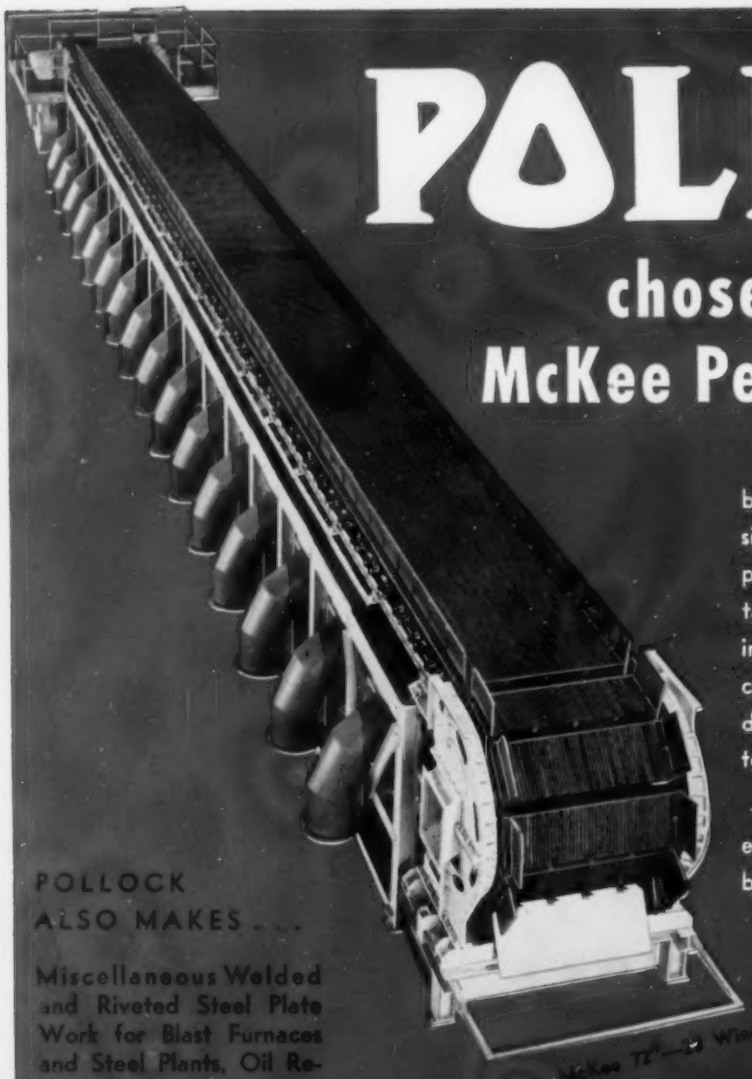
HEAVY HARDWARE
Complete Line Wire Rope Fittings and Cutters, Bar Benders and Cutters.

YOUR INQUIRY WILL PROMPTLY BRING DETAILED INFORMATION PERTAINING TO ANY OF THE ABOVE FARRELL-CHEEK PRODUCTS

SANDUSKY, OHIO

POLLOCK

chosen to construct McKee Pelletizing Machines



McKee 72'—52 Windbox Pelletizing Machine

The William B. Pollock Company has been chosen by Arthur G. McKee & Company to construct the six (6) pelletizing machines for Reserve Mining Company's new plant at Silver Bay, Minnesota, to process taconite. These pelletizing machines will be built in Pollock's Youngstown, Ohio, plant, shop-erected complete, test run, then thoroughly match-marked, disassembled, and shipped by rail in such a way as to insure quick and efficient field erection.

Pollock is known the world over for its reliable, efficient, heavy steel construction. You, too, can benefit from Pollock's broad experience.

POLLOCK ALSO MAKES . . .

Miscellaneous Welded and Riveted Steel Plate Work for Blast Furnaces and Steel Plants, Oil Refineries, Chemical Plants and Allied Industries.

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Discharge End

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Basically designed as required by A.I.S.E. specifications, mill type cranes built by Victor R. Browning & Co., Inc. also offer the opportunity of specifying preferences and standards prevailing in the purchaser's plant. May we have your next inquiry?

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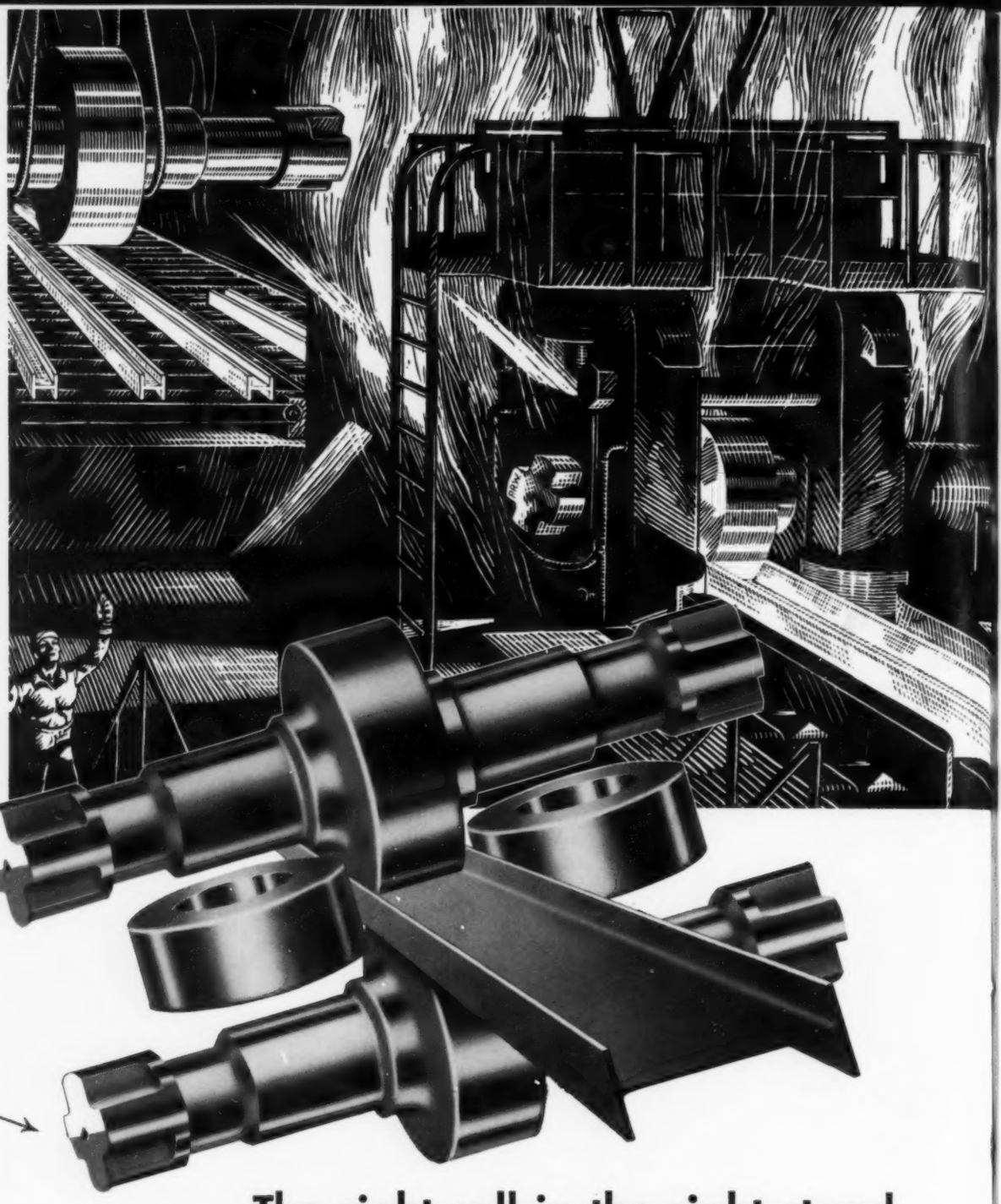

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Personnel News...

J. D. Rollins has been appointed vice president—engineering of United States Steel Corp.'s American Bridge Division. In this newly created position he will be in general charge of all engineering activities. **James W. Kinnear, Jr.** succeeds Mr. Rollins as assistant vice president—engineering U. S. Steel Corp. At the same time, **William E. Crouch, Jr.** was appointed to succeed Mr. Kinnear as general superintendent of the Edgar Thomson Works, Braddock, Pa. Mr. Rollins started with U. S. Steel in Pittsburgh in 1934, and in 1937 was transferred to the Gary Steel Works, Gary, Ind., where he remained 11 years, progressing to the position of works chief engineer. In 1948 he returned to Pittsburgh as planning engineer, and in 1950 was made assistant chief engineer of the then Carnegie-Illinois Steel Corp. With the formation of U. S. Steel Co. in 1951, he was made assistant chief engineer—manufacturing, and the following year was named assistant vice president—engineering for U. S. Steel Corp. Mr. Kinnear started with U. S. Steel as an open hearth laborer at Homestead Works in 1923. Advancing through various positions in the open hearth shops, he was transferred to the metallurgical department in 1932, becoming chief metallurgist at the plant in 1933 and assistant general superintendent in 1937. He was transferred in 1940 to the general offices in Pittsburgh, as assistant manager of operations. In 1947 he left the company to become president of Firth Sterling Steel and Carbide Corp., and in 1951 returned to U. S. Steel as assistant to the vice president—manufacturing. On September 1, 1951, he was appointed general superintendent of Edgar Thomson Works. Mr. Crouch began with U. S. Steel in 1933 as a clerk in the metallurgical department at Homestead Works. He held various positions in the structural and 100-in. mills before being made assistant superintendent of industrial relations in 1941. He was named superintendent of the plant's 160-in. plate mill in 1943, and assistant superintendent of the slabbing and plate division in January, 1949, becoming superintendent of the division in 1951. He was transferred to Edgar Thomson Works in 1952 as assistant general superintendent, the position he held at the time of his present appointment.

Philip J. Bornhorst was appointed division superintendent, coke and coal chemicals works of Clairton Works, United States Steel Corp. Other appointments announced were: **Robert R. Campbell** as assistant division superintendent; **Howard G. Cooper,** superintendent, tar plant; and **John W. Levergood,** superintendent, benzol department. Mr. Bornhorst had been assistant division superintendent of the coke and coal chemicals works since July, 1950.

Paul R. Totten was promoted to division superintendent at the Allenport Sheet Division of Pittsburgh Steel Co. **William C. Ackerman** has been named assistant divisional superintendent. Mr. Totten joined the Thomas Steel Co., now the Thomas Strip Division of Pittsburgh Steel as plant metallurgist in 1948. After advancing to assistant superintendent of rolling, annealing and finishing at Thomas, he transferred to Allenport to serve as a consultant in starting up the new cold rolled sheet mill. In March, 1954, he was appointed superintendent of cold reduction, and in October of that year advanced to assistant division superintendent. Mr. Ackerman entered the steel business in 1936 with Jones & Laughlin Steel Corp., advancing to foreman of the pickle line by 1951. In that year, he joined Marsam Steel Co. as superintendent. When operations began at Pittsburgh Steel Co.'s new hot rolling mill in 1953, he joined the company as training supervisor. He then became general foreman of the continuous pickle line, and in October of 1954, was promoted to superintendent of cold reduction and finishing.

Roger M. Wolcott, formerly open hearth superintendent of the Pittsburgh Works, Jones & Laughlin Steel Corp., was promoted to assistant to the vice president—engineering and plant. **John F. Pollack** was named superintendent of the open hearth at Pittsburgh Works, succeeding Mr. Wolcott. He was formerly assistant superintendent. **Walter T. Sergy,** formerly general foreman in the No. 4 open hearth shop at Pittsburgh Works was promoted to assistant superintendent of the open hearth department.

Frederic L. Moffet has been appointed chief metallurgist of Crucible Steel Co. of America's Park works in Pittsburgh. In his new assignment, Mr. Moffet heads a department of 40 metallurgists, chemists, and technicians at Park works.

J. D. ROLLINS

JAMES W. KINNEAR, JR.

WILLIAM E. CROUCH, JR.

PHILIP J. BORNHORST

JOHN W. LINDSEY

T. J. PETERS

ROBERT E. HARVEY

JAMES K. MAGEE

John W. Lindsey has been appointed to the newly-created post of director of purchases for Jones & Laughlin Steel Corp. He formerly was J&L's general purchasing agent.

T. J. Peters has been appointed director of maintenance and construction by Acme Steel Co. He will be located at the company's plant in Riverdale, Ill. Before joining Acme, Mr. Peters was division superintendent in charge of plant maintenance, construction and salvage for the South Works plant of U. S. Steel Corp.

Robert E. Harvey has been appointed executive vice president in charge of the Steel Division of Merritt-Chapman & Scott Corp. The division is comprised of Newport Steel Corp. and Milton Steel Products Division. Mr. Harvey, a member of the board, continues to serve as executive vice president and general manager of Newport Steel.

James K. Magee, formerly assistant superintendent of Blast Furnace at the Duquesne works, U. S. Steel Corp., has been appointed assistant to general superintendent.

R. Grant Fleck was named as manager of the New York Ore Division, Jones & Laughlin Steel Corp. The division, formerly known as Benson Mines, includes a large open-pit iron ore mining operation and a complete beneficiating plant. **R. E. Durocher,** plant metallurgist, succeeds Mr. Fleck as assistant manager of the division. Mr. Fleck joined J&L in 1945 as plant metallurgist and chief inspector at the Electricweld Tube Division at Oil City, Pa. He was named plant metallurgist at Benson Mines in 1946 and assistant general superintendent of the division in 1950. Mr. Fleck started his career in the steel industry in the blast furnace department of Republic Steel in 1934.

J. F. VanCleave has been appointed assistant to the vice president at Detroit Steel Corp., Detroit, Mich. Other appointments announced were: **F. E. Weise, Jr.** as assistant to the general superintendent; and **A. E. Albrecht,** superintendent in charge of the blooming, bar and hot rolled strip mills.

Dr. E. W. Volkmann has been appointed manager, research department, of Koppers Co., Inc. In this position, Dr. Volkmann will be responsible for the coordination of all Koppers research, including work at its Verona, Pa. research center, and elsewhere in the country. At the same time, **Dr. A. R. Powell,** who has been acting manager of the department, has been appointed special research adviser and will be available for advice on all research and development problems.

T. M. Stonerod was appointed general sales manager of Brooks Oil Co., with headquarters in Pittsburgh. Previously he had been assistant to the vice president of sales and engineering, in which post he served as

T. M. STONEROD

head of Brooks' Mining Sales Division. Mr. Stonerod joined the company in 1940 as a sales engineer. In 1946 he became sales manager of the company's Pittsburgh District, a position he held until he was named assistant to the vice president in 1953.

Roy D. Palmer, formerly associated with Aluminum Co. of America and Aluminum, Ltd., was named industrial consultant with Loewy-Hydropress.

Fred K. Whiteside was named to the New England sales district of Selas Corp. of America, as sales and

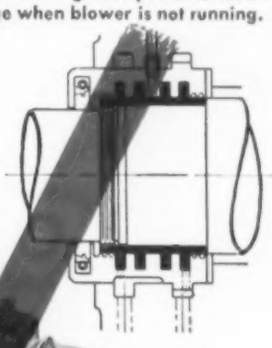
ALLIS-CHALMERS

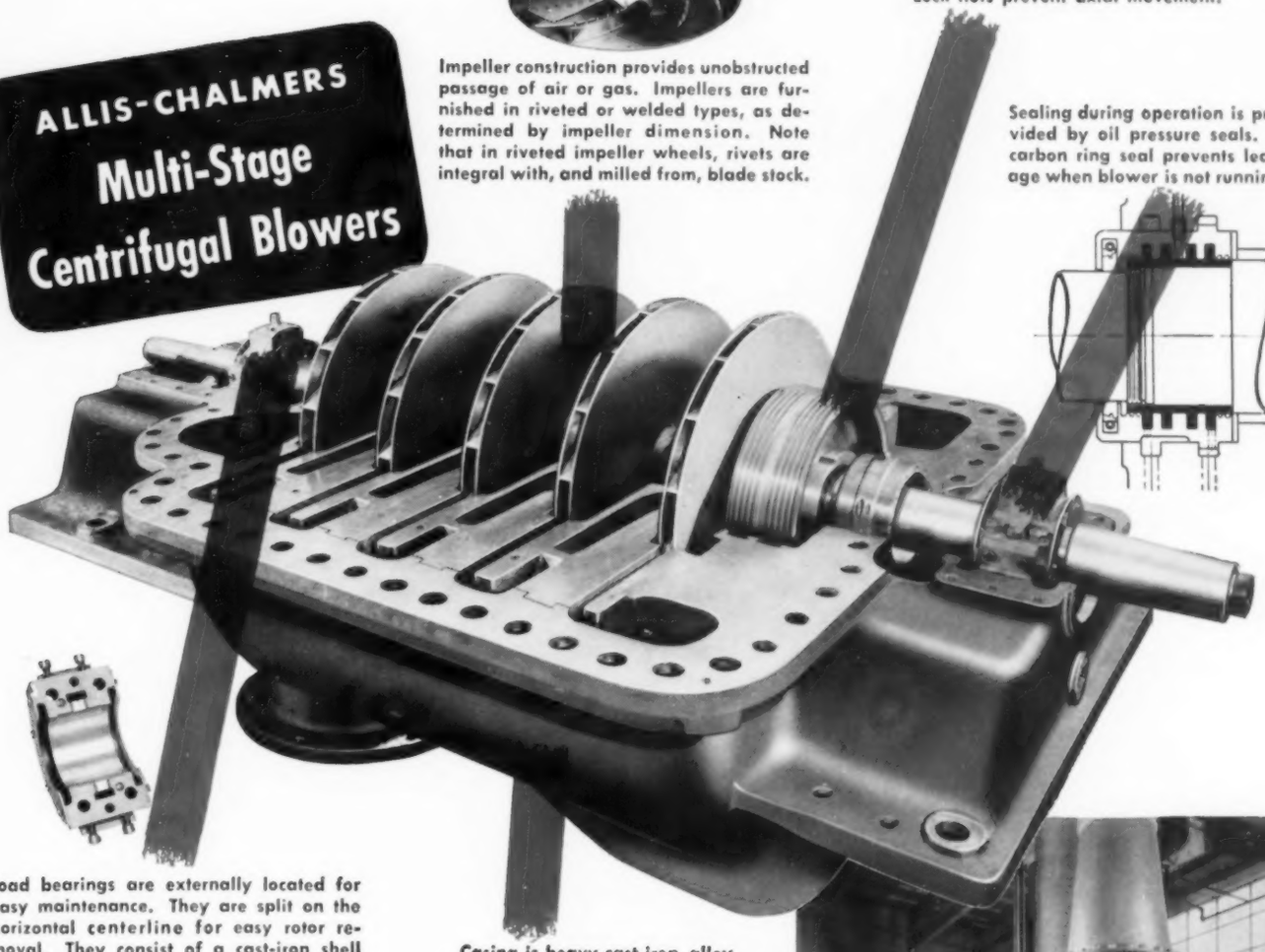
Multi-Stage Centrifugal Blowers

Impeller construction provides unobstructed passage of air or gas. Impellers are furnished in riveted or welded types, as determined by impeller dimension. Note that in riveted impeller wheels, rivets are integral with, and milled from, blade stock.

Impeller wheels are located accurately on shaft with sleeves and are mounted with light shrink fit. Bores are ground to size. Lock nuts prevent axial movement.

Sealing during operation is provided by oil pressure seals. A carbon ring seal prevents leakage when blower is not running.





Load bearings are externally located for easy maintenance. They are split on the horizontal centerline for easy rotor removal. They consist of a cast-iron shell with removable, babbit-lined steel inserts.

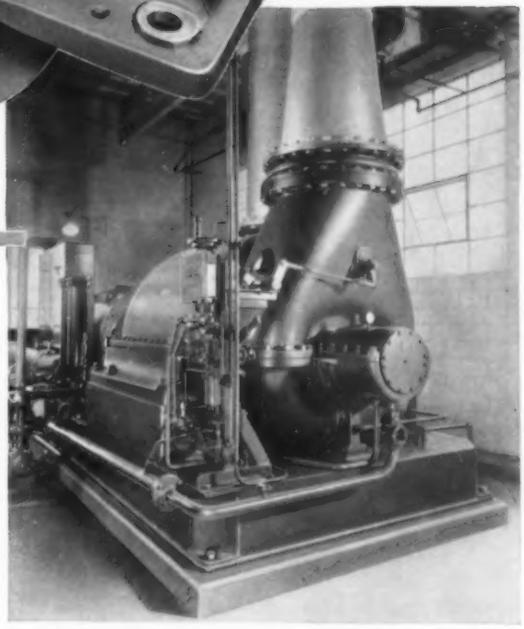
Casing is heavy cast iron, alloy, or forged steel.

Why these blowers can run for years *without stopping*

The key to "round the clock" performance is *quality*, as illustrated in the features above.

For highly dependable, low maintenance air and gas handling equipment, as well as motors and control, call your nearby Allis-Chalmers office, or write Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4530



This Allis-Chalmers four-stage centrifugal blower supplies 24,000 cfm to the catalytic cracking tower of an eastern refinery on a 24-hour-a-day basis, month in and month out.

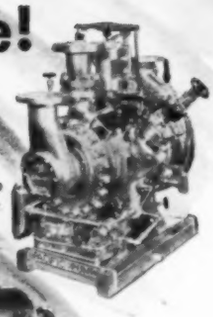
ALLIS-CHALMERS

A-C ALLIS-CHALMERS

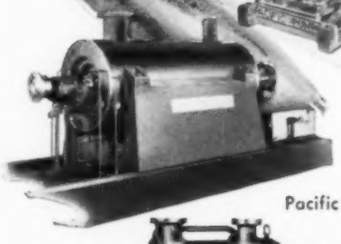
It takes a lot of water to fill a 7-foot pipe!

To bring the hot water to all the Pacific Boiler Feed Pumps placed in operation in 1953 would require a pipe 7 feet in diameter...

Today practically all of the large power generating companies throughout the United States have one or more Pacific Pumps in feed water service. Pacific Boiler Feed Pumps now operating include small vertical type units handling 47,700 pounds per hour at 710 psig discharge pressure—to very large horizontal type units handling 800,000 pounds per hour at 2430 psig discharge pressure. Bulletins 106, 109 and 118 giving details available on request.



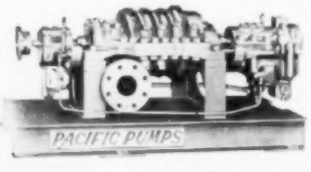
Pacific Steam Turbopump



Pacific Type IBF

Pacific Type ABF

Specify **Pacific**
CENTRIFUGAL BOILER FEED PUMPS



Pacific Type JBF

Pacific Pumps inc. HUNTINGTON PARK, CALIFORNIA
ONE OF THE DRESSER INDUSTRIES
Export office: Chanin Building, 122 East 42nd Street, New York
Offices in all principal cities

BF-19

engineering representative. Mr. Whiteside has been associated with W. S. Rockwell Co. for the past 10 years and since 1952 has been general sales manager of the furnace and oven division. He has previously served with Brooklyn Union Gas Co. as industrial gas engineer, with Surface Combustion Corp. as sales engineer and with the Research Institute of Combustion Utilities Corp. of New York City.

William H. Kinney has been appointed resident metallurgical engineer for Kaiser Steel Corp., in Oakland, Calif. He will act as liaison on all metallurgical development work between northern Calif. customers and the company's sales and metallurgical departments and operating divisions.

Russell J. Geitman has been appointed chief engineer for Link-Belt Co.'s plant in San Francisco, Calif. He will direct the design of all equipment made at this plant.

Reid Pittenger was named manager of industrial relations of Copperweld Steel Co.'s Ohio Seamless Division and **Raymond E. Dewey** was named manager of operations. Mr. Pittenger was formerly assistant works manager. Mr. Dewey was formerly chief engineer.

Edward C. Hirsch has been appointed to the Pittsburgh district sales staff of J. H. France Refractories Co. Prior to joining France, he served as a sales representative for Banks Morton Co. He has also been affiliated with the Pittsburgh Carbon Corp. and National Supply Co.

Robert F. Renkin has been appointed research and development engineer at Sharon Steel Corp.'s Roemer works. **George D. Myers,** superintendent of the hot strip finishing division, will assume the additional duties of superintendent of coating.

Dr. James T. Eaton was elected to fill the newly created position of vice president—production of E. F. Houghton & Co. Dr. Eaton was formerly director of research. In his new position, Dr. Eaton will assume responsibility of Houghton's oil manufacturing plants and continue to head the research staff.

W. A. Marquardt has been appointed assistant manager of D. J. Murray Manufacturing Co. In his new capacity he will assist the president and general manager in management affairs.

Nelson M. McGuire was named assistant to the vice president for sales, American Manganese Steel Division of American Brake Shoe Co.

Irvin E. Walton, purchasing agent of Heppenstall Co. was named vice president in charge of purchases and traffic, and **Howard G. Grim,** general manager of operations was appointed vice president in charge of manufacturing.

James L. Duchene was named Baldwin-Lima-Hamilton Corp. sales engineer for iron and bronze foundry products in western Pa., northern W. Va., and southern Ohio. Prior to joining Baldwin, Mr. Duchene was sales representative for National Bearing Division, American Brake Shoe Co.

B. J. "Barney" Osborne has been appointed assistant to the vice president and general manager of Kaiser Steel Corp. and placed in charge of the company's new fabricating division. The division will operate the plant and facilities recently acquired by Kaiser from the Union Steel Co. of Los Angeles.

Clarence H. Verwohlt has retired as chief plant engineer and superintendent of maintenance, Beech Bottom Works, Wheeling Steel Corp. Mr. Verwohlt began his career in 1911 with Wheeling Corrugating Co., subsidiary of Whitaker-Glessner Co., predecessor to Wheeling Steel. He worked in the engineering department at the Wheeling factory until 1918 when he became chief engineer of the Wheeling District Mills. In 1932 he was made chief engineer of the Beech Bottom Works, and in 1942 became assistant superintendent of the maintenance department at the Benwood Works. In 1944 he returned to the Beech Bottom works as chief plant engineer and superintendent of maintenance, which position he retained until his retirement.

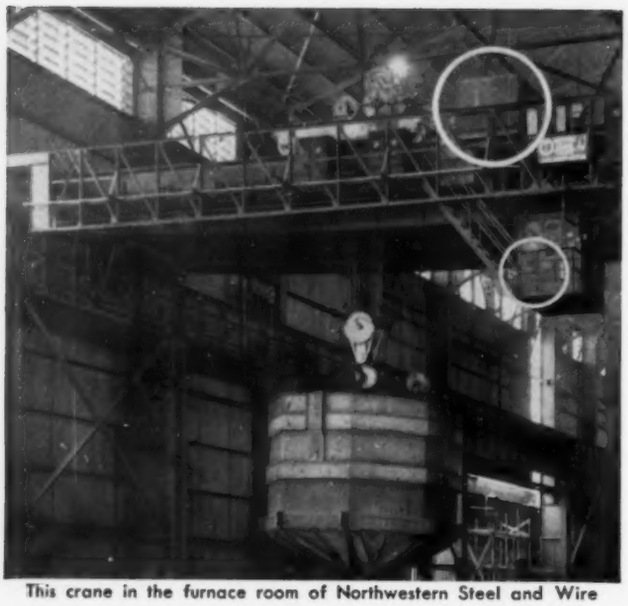
D. R. Thrush has been appointed chief design engineer of cranes at the Morgan Engineering Co. Before

WILLIAM H. KINNEY

RUSSELL J. GEITMAN

REID PITTENGER

RAYMOND E. DEWEY



This crane in the furnace room of Northwestern Steel and Wire Company's new West Mill at Sterling, Illinois, was installed by the Bedford Foundry and Machine Company. Its cab is air conditioned with an Aire-Rectifier—one of many Lintern air conditioning units purchased by this company over the past several years.

how AIRE-RECTIFIERS help keep costs down...

Even when mills run at normal production, it is equally important, as at low production, to keep costs down, yet obtain maximum output from cranes and crane operators.

Lintern Aire-Rectifiers provide: increased production due to men working under normal, healthful conditions; improved personnel relations; reduction of wild cat work stoppages; elimination of relief men and premium rates. These savings soon equal the capital investment for an Aire-Rectifier.

Many exclusive features make Lintern Aire-Rectifiers the choice of practically every steel and industrial plant using air conditioning on crane cabs and pulpits — features which assure unequalled cooling and filtering of the air at the lowest possible cost — features which have proven their worth in hundreds of applications while keeping maintenance costs at a minimum.

Ask for new Builetin AC-549.

Also Bulletin P-552 on Pulpit Air Conditioning

THE LINTERN CORPORATION

ROUTE 20, EAST • PAINESVILLE, OHIO

joining Morgan, Mr. Thrush was crane engineer at Great Lakes Steel Corp. He will be responsible for the design of ladle, soaking pit, gantry, and industrial cranes in the 5 to 300-ton range. He will also consult on steel mills, shears, and other heavy equipment.

Dr. James A. Krumhansl has joined the staff of the research laboratories of National Carbon Co., as assistant director of research. Dr. Krumhansl will be located in Cleveland at the company's new research center, now under construction. He was formerly associate professor of physics at Cornell University.

Alfred A. Paul has been appointed manager of services of Brooks Oil Co. For the past ten years he had been in charge of Brooks' Chicago sales district and warehouse.

ALFRED A. PAUL

R. B. Osbourne has been elected to the newly-created post of vice president-engineering of Phillips Corp. **John Graham** was named treasurer of the firm to fill a vacancy left by the death last year of **John E. Roth.**

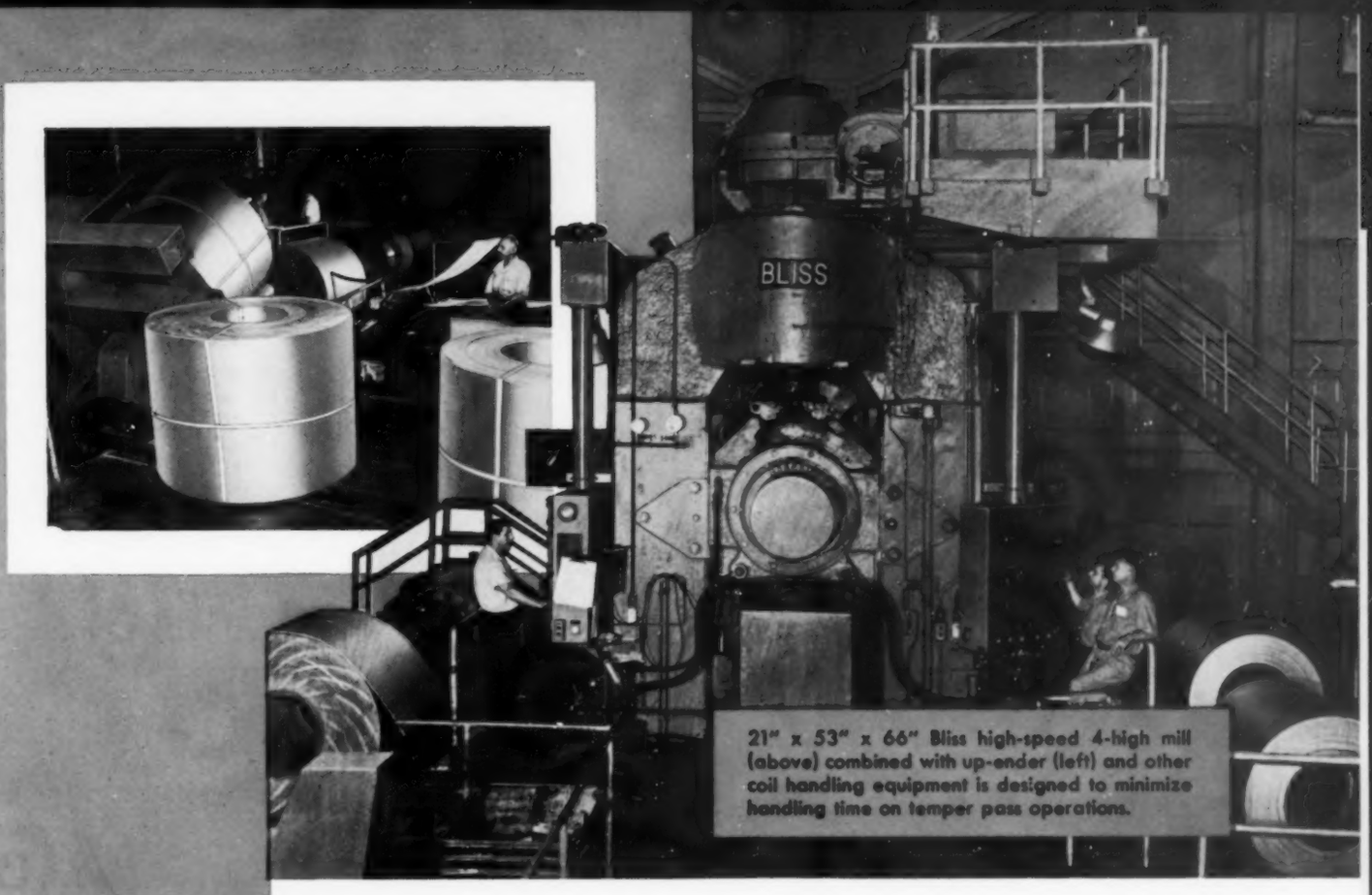
S. Charles Knight has been appointed general traffic manager for Kaiser Steel Corp. Mr. Knight joined Kaiser in 1949 as assistant general traffic manager. Before that he held the same position with Kaiser Aluminum and Chemical Corp. in Oakland from 1946.

Richard A. Biggs was appointed manager, product development, of the Stainless Division of Crucible Steel Co. of America.

James Kelso, Jr. has been appointed field representative for Delta-Star Electric Division, H. K. Porter Co., Inc., to take over territory in the New England states. Mr. Kelso was formerly an application engineer for Allis-Chalmers in their Boston office.

Andrew H. Bowman has been promoted to the position of assistant secretary of Wheeling Steel Corp.

Rainey Elliott has been named president of the supply division of Jones & Laughlin Steel Corp. Mr. Elliott was named general manager of the division in



21" x 53" x 66" Bliss high-speed 4-high mill (above) combined with up-ender (left) and other coil handling equipment is designed to minimize handling time on temper pass operations.

BLISS mill at the Ford steel plant designed to give OPTIMUM MILL USE

Looking for ways to cut down on idle rolling mill time? Most metal producers are. Then consider the recent Bliss installations at Ford Motor Company's great Rouge plant where the new Bliss 4-High Temper mill was designed to do just that.

Bliss engineers approached the problem by combining the most advanced coil handling equipment and electric controls with a new high-speed mill. The entire installation was engineered to Ford's rigid requirements for providing optimum mill use on temper pass rolling. Here's how Bliss designed to meet these specifications:

Speedier coil handling—entry conveyors, up-ender, coil positioning and preparation cradle, and reels operate faster; give unprecedented protection to coil edges and operating personnel.

Heavier coils used—weighing up to 56,000 lbs. each, in maximum 60" widths, and maximum 72" O.D.; larger coils mean less frequent "threading".

Continuous Strip inspection—facilitated by special electric devices and engineered vantage points of inspection.

Roll changeover is quick and easy—with motorized equipment.

Screwdown settings and adjustments—made more quickly due to highly powered electric equipment with fine control.

If you have a mill equipment problem, do as other leading mill users do. Consult BLISS. Meanwhile, write for your copy of our revised 60-page brochure. Bulletin 40-A.

Remember: BLISS **is more than a name . . . it's a guarantee**

E. W. Bliss Company • General Office: Canton, Ohio

ROLLING MILL DIVISION: SALEM, OHIO

U. S. Plants in Canton, Cleveland, Salem and Toledo, Ohio; Detroit and Hastings, Michigan; San Jose, California.

Branch Offices in Buffalo, Chicago, Cleveland, Dayton, Detroit, Indianapolis, Los Angeles (Burbank), New Haven, New York, Philadelphia, Rochester, San Jose, Toledo, Washington, D. C., and Toronto, Canada. Other representatives throughout the world.

December of 1952. He had been vice president and director of the J&L supply company prior to its incorporation into J&L as a division on that date.

G. Lupton Broomell, Jr., has been appointed chief engineer of Leeds & Northrup Co. Joining Leeds &

G. LUPTON BROOMELL, JR.

Northrup in 1937, Mr. Broomell became successively head of the recorder development section, and assistant chief engineer.

Fred H. McCurdy, Jr. has been appointed manager of the Chicago district of the Brooks Oil Co. He has been associated with the company as a sales engineer in the Pittsburgh District since 1948.

FRED H. McCURDY, JR.

Edward B. Story, chief metallurgist at A. M. Byers Co. has retired after 38 years service. He will be retained by the company in the capacity of consultant.

Harry M. Pier, formerly general sales manager of Research-Cottrell, Inc. has been appointed special assistant to the chairman of the board to conduct new studies in the field of atmospheric pollution. Mr. Pier will coordinate the activities of Research-Cottrell, Inc. with those of industry, research and educational institutions and other interested organizations in this field. **Charles E. Beaver,** formerly assistant sales manager, succeeds Mr. Pier as general sales manager.

Howard C. Parkman was named assistant vice president—operations, of Vanadium Corp. of America. He was previously plant manager at Niagara Falls. **R. T. Bailey** was named assistant to the vice president —production manager, with headquarters in New York City. Mr. Bailey was formerly assistant plant manager at Niagara Falls. **C. A. J. Schulte,** formerly superintendent of furnace operations, has succeeded Mr. Parkman as plant manager at Niagara Falls. **C. W. Mauk** succeeds Mr. Schulte as superintendent of furnace operations.

Walter R. Stendahl was appointed district traffic manager of Crucible Steel Co. of America at New York and **Daniel G. Donovan** was named district traffic manager at Pittsburgh.

William J. Ryan has been appointed assistant to the executive vice president and general manager of the Cleveland Crane & Engineering Co. Mr. Ryan was formerly personnel manager and office manager.

WILLIAM J. RYAN

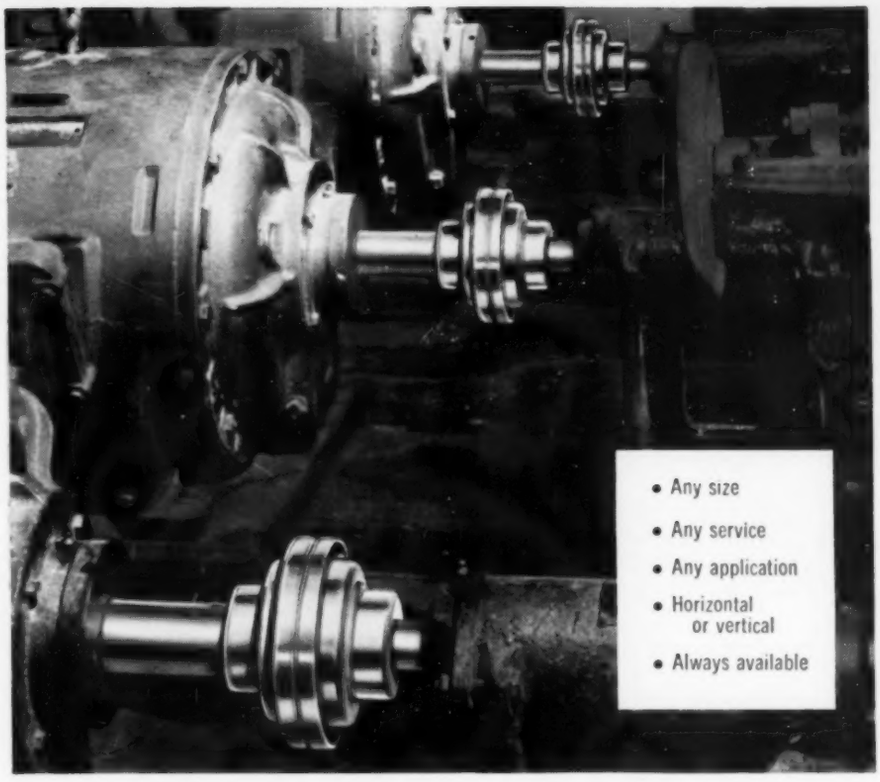
Eugene Easterly has been appointed vice president, distribution, and **E. D. Hickling,** vice president, operations, of Linde Air Products Co.

Lewis W. Bentley was appointed manager of the Detroit office of Industrial Crane & Hoist Corp., now located at 18431 James Couzens Highway, Detroit 35, Mich.

L. L. Cook, general superintendent of glass industry refractories and refractory specialties of Laclede-Christy Co., has been promoted to district works manager. Mr. Cook will be in charge of the production of glass industry refractories and specialties, silica brick made in St. Louis, and vitrified clay pipe and drain tile. He has been in the Operations Division of Laclede-Christy since 1940.

Louis G. Helmick, Jr., has been elected vice president of manufacturing of Joy Manufacturing Co. He was formerly manager of manufacturing.

E. P. Best was named chief metallurgist at the Ambridge, Pa. plant of A. M. Byers Co. He is succeeded



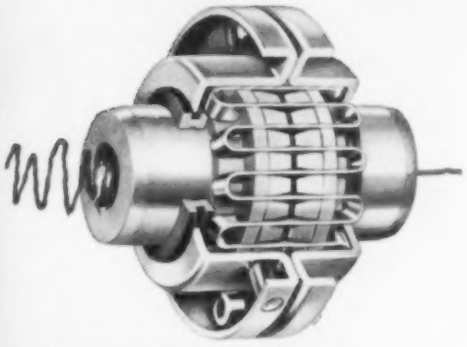
FALK Steelflex Couplings save you money by prolonging the work-life of connected machinery

Ever since the first Falk Steelflex Coupling was designed and built, more than thirty years ago, we have firmly held to these beliefs:

1. A coupling, to give fullest value, must do more than merely connect driving and driven machinery—it must protect the machinery and prolong its life.
2. A coupling, to be truly flexible, must overcome the effects of shock and vibration, as well as shaft misalignment (see column at right).

Proof of the soundness of these beliefs is furnished by the record. Many Falk Steelflex Couplings installed 10, 20, even 30 years ago are still giving trouble-free service—still providing maximum protection for the machinery they connect!

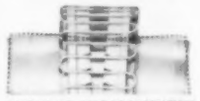
A single basic type—the world-famous Type F—fills nine out of ten industrial application needs. Versatile, efficient and economical, it is always quickly available, in a wide range of sizes, regardless of your location. Write to Department 247 for engineering bulletin, including selection and dimension details.



How Torsional Resilience smothers shock and vibration

The steel gridmember connecting hubs fits snugly only at outer edges of tapered hub-teeth. As load increases, gridmember flexes against teeth in proportion to load, providing cushion that spreads peak loads over longer time increment and reduces stresses in machinery.

UNDER NORMAL LOAD


ANGULAR MISALIGNMENT

...Accommodates shaft misalignment... Permits free end float

The exclusive FALK all-steel grid-groove design provides compensation for parallel and angular shaft misalignment . . . permits free end float.

PARALLEL MISALIGNMENT
FREE END FLOAT

Special or Dual Purpose FALK Steelflex Couplings for problem applications

LIMITED SPACE
Type FS

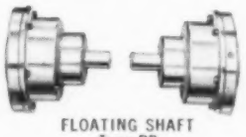
RAPID REVERSING SERVICE—Type CM

HIGH SPEEDS
Types H and HH

BRAKEWHEEL SERVICE
Type BW

OVERLOAD CONTROL
Type FT

EXTENDED SHAFT
Type P


FLOATING SHAFT
Type PP

Do you have a coupling problem?

If so, describe it in writing—we will gladly recommend the proper Steelflex coupling for your needs. Write to Department 247.

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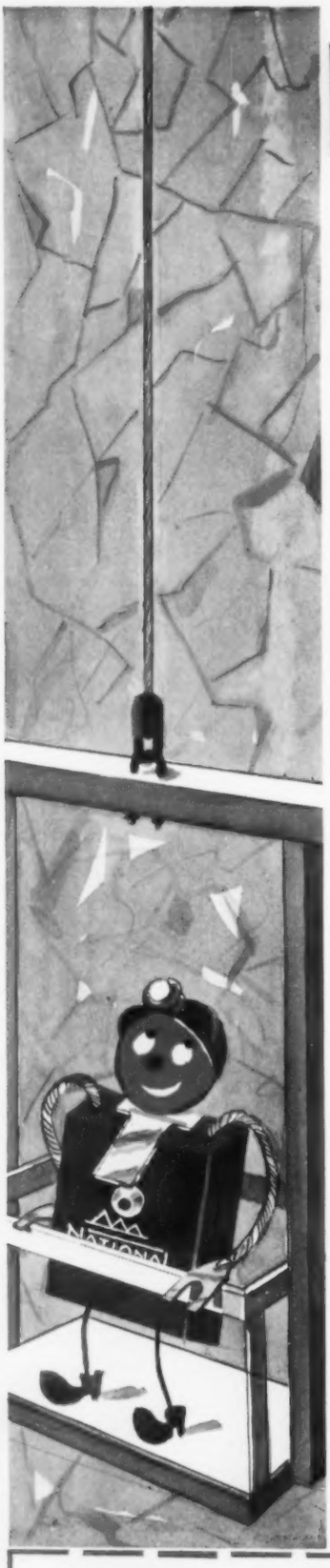

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LOOK LOW...

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TRADE-MARK

ARE YOUR BEST BUY ALL THROUGH MINE AND MILL

The "National" brush line is a *complete* line—offering grades, sizes and types specifically designed for the wide range of operating conditions found in rotary d-c equipment.

COMMUTATION A PROBLEM?

National Carbon research in this field is almost alone responsible for the many special-purpose, high-commutation brush grades, now standard in the industry.

COMMUTATOR FILM ACTING UP?

"National" brushes' special film-control properties are especially effective in eliminating film breakdown and threading under difficult extremes of current density and sudden load-swing.

CONCERNED OVER BRUSH LIFE?

With the entire "National" brush line to choose from, you are certain of getting maximum brush life consistent with overall satisfactory brush performance.

There are far more "National" brushes working in mine and mill than any other brand. Find out for yourself why "National" brushes are preferred for main drives and generators, heavy-duty general-purpose and mill-type motors.

The term "National", the Three Pyramids Device and the Silver Colored Cable Strand are registered trade-marks of Union Carbide and Carbon Corporation

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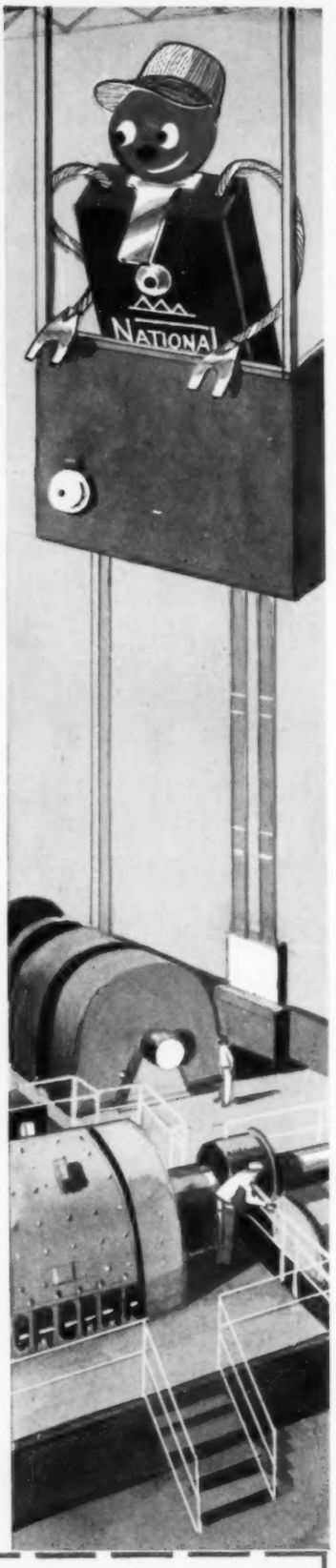

YOURS FOR THE ASKING . . . National Carbon's instructive pamphlet series on the practical aspects of motor and generator maintenance. Supervisors should request as many copies as they need to distribute personally to their men. Coupon automatically brings back-issues and each new, bi-monthly issue for two years or more.

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as assistant chief metallurgist by **E. K. Foss.** Mr. Best served for a time as assistant to the general superintendent at the company's old Girard, Ohio, plant. In 1930 he went to Ambridge as works metallurgist and was later named assistant chief metallurgist.

R. Gordon Edgar was recently appointed assistant roll designer at the Pueblo Plant of Colorado Fuel and Iron Corp. Mr. Edgar has been at Pueblo since 1938. Prior to this new appointment, Mr. Edgar was general foreman in the roll shop.

Paul L. Bruhn has been appointed acting works manager of Republic Steel Corp.'s Berger Division. **E. T. Causer,** who has been works manager at the Berger Division since 1936, will continue with Republic in a consulting capacity.

M. J. Boho, vice president and general manager of Hagan Corp., has been elected a director of the company and its subsidiaries, Calgon, Inc., Hall Laboratories, Inc., and the Buromin Co. He joined Hagan in 1936, becoming assistant general sales manager in 1942, vice president in charge of sales in 1948, and vice president and general manager of Hagan and all its subsidiaries in 1954.

John J. Selway has been named general manager of Barium Steel Corp.'s Chester Blast Furnace, Inc. Mr. Selway was formerly superintendent of the Ben Woods Works Furnace of Wheeling Steel, and has been connected with Wierton, U. S. Steel, and Republic. **Wade H. Oldham** formerly general manager, will continue with the company as vice president.

Ralph E. Holmes was named manager of Republic Flow Meters Co. Philadelphia district. **Sten Hammarstrom** succeeds Mr. Holmes as manager of the company's Cincinnati district.

Obituaries

Thomas Sydney Quinn, co-founder and treasurer of Lebanon Steel Foundry, died February 20. In 1907, Mr. Quinn took his first job with Colorado Fuel and Iron Co., as assistant blower on bessemer converters and later transferred to the open hearth operation. During 1909 and 1910 he was associated with the American Iron & Steel Manufacturing Co. and with Lebanon Steel Casting Co., a subsidiary of the Treadwell Engineering Co. On December 11, 1911, he helped found the Lebanon Steel Foundry, serving as treasurer and general manager until April 1, 1954, when his duties as general manager were assigned to a son.

Donald H. Montgomery, veteran chief European engineer of the rolling mill division of E. W. Bliss Co., died on a recent business trip. Mr. Montgomery, who joined the company in 1925 served as engineer and sales engineer prior to his European assignment in 1949.

Darry G. Holt, age 59, assistant superintendent, maintenance, Midland Works, Crucible Steel Co. of America, died January 30. Mr. Holt had been associated with Crucible since 1951. He had been with U. S. Steel for 16 years as maintenance superintendent

DARRY G. HOLT

at various plants. He was assistant manager of E. W. Bliss Co. from 1940 to 1948, and superintendent of maintenance, Cia de Acero, Chile, from 1948 to 1951.

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From Shear Line to Shipping

A 14-foot Mansaver, working at the shear line of a large steel plant, lifts 2 packages of 36 x 120 cold-rolled sheets weighing over 7 tons. Note that this same grab also takes other

widths and lengths of sheet. Supplied hand-operated as shown or motor-driven. Other models handle coils, tinplate, etc.

Mansavers pay their way with concrete savings in time, plus *improved* safety. Write for name of nearest representative, who will be glad to show how this applies to your plant.

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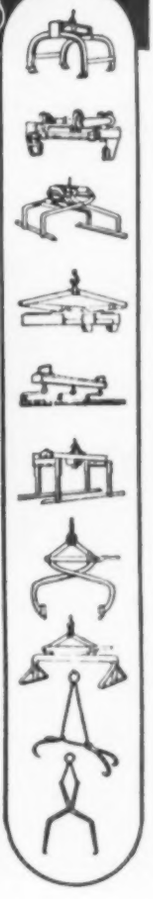
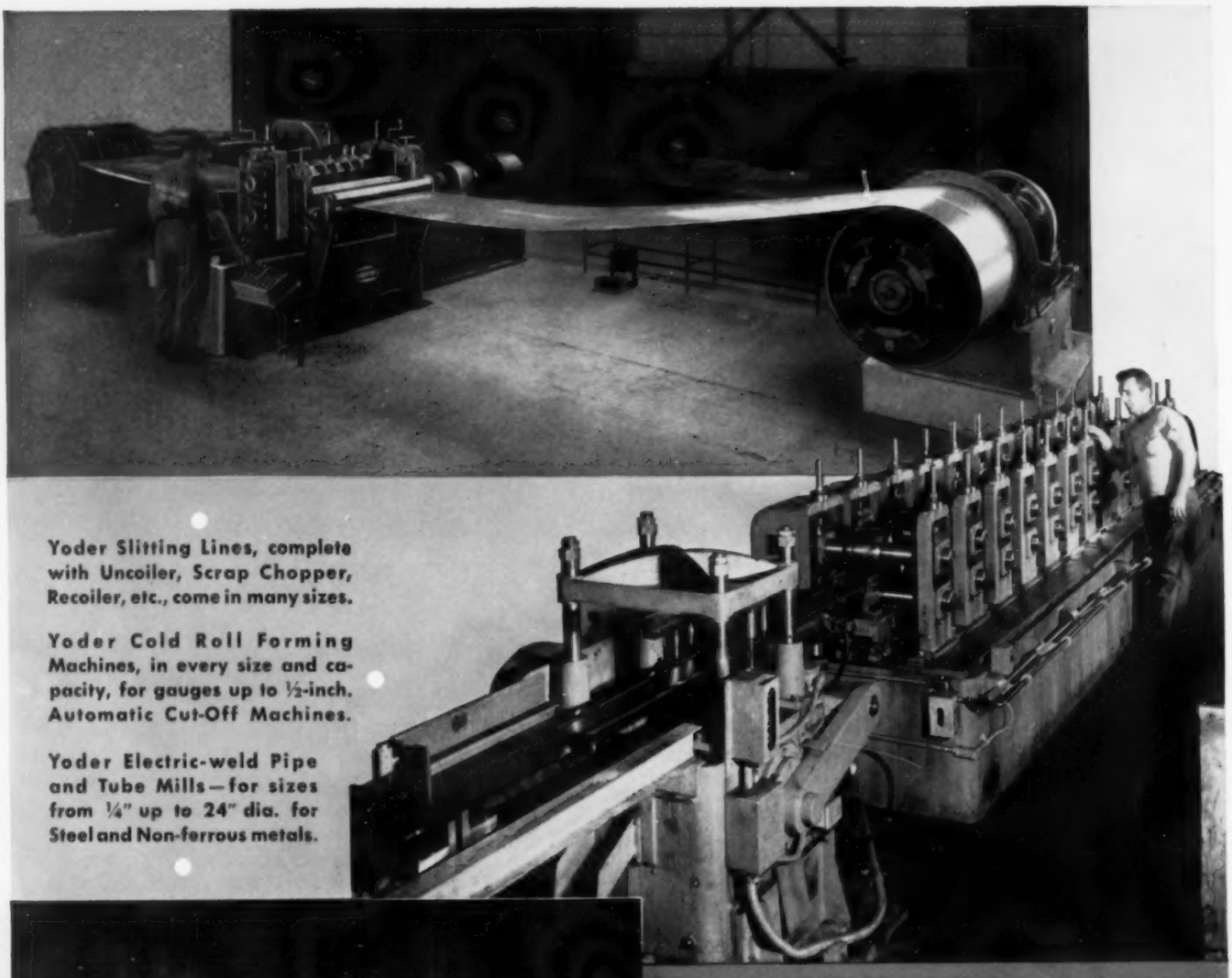
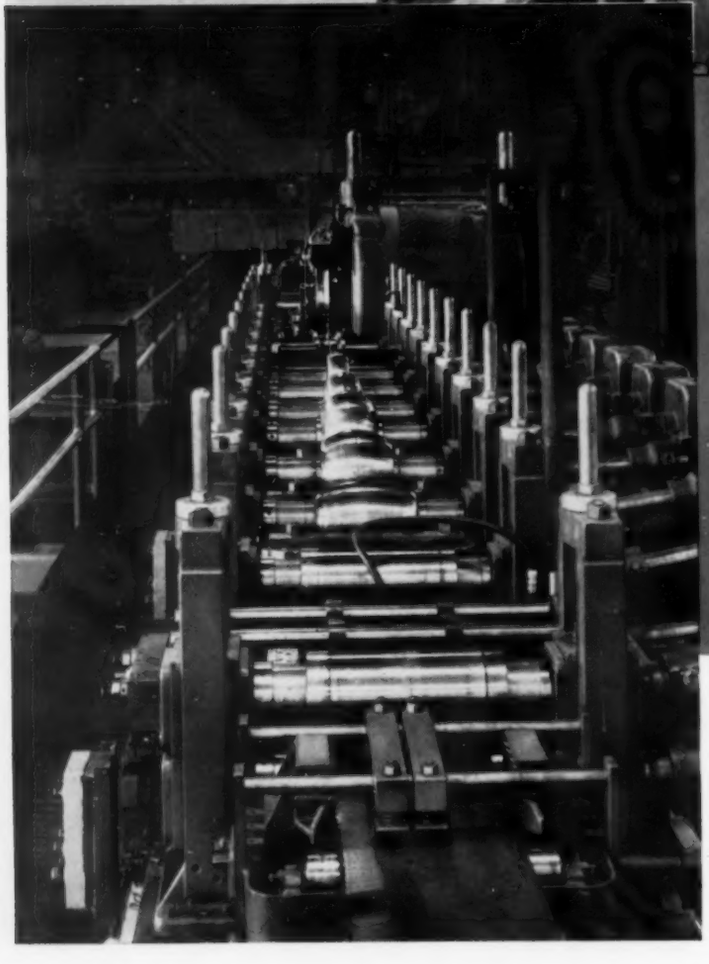




Yoder Slitting Lines, complete with Uncoiler, Scrap Chopper, Recoiler, etc., come in many sizes.

Yoder Cold Roll Forming Machines, in every size and capacity, for gauges up to ½-inch. Automatic Cut-Off Machines.

Yoder Electric-weld Pipe and Tube Mills—for sizes from ¼" up to 24" dia. for Steel and Non-ferrous metals.



• Slitting Lines
• Cold-Roll Forming
MACHINES
ELECTRIC-WELD
• Tube Mills
for FERROUS and NON-FERROUS METALS

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Note: Post cards expire three months after publication date.

(1) Rotary Straightener

The subject of straightening ferrous and non-ferrous pipe and tube is discussed in a new bulletin available from Mackintosh-Hemphill Co. The bulletin reviews the many new uses for tubing that have developed in recent years. Reasons for having straight tube prior to forming and fabricating operations are presented. Several pages in the 24-page brochure analyze the two basic straightening methods—two plane vs rotary machines. Detailed explanation is given on the superiority of rotary straightening as accomplished by rotary straighteners. Other subjects covered include: a presentation on how to adjust and most efficiently operate a rotary straightener; the design and use of entry and delivery tables; flood lubrication; single and multi-speed drives vs variable speed drives, and the design and performance of straightening rolls in a rotary type machine. Two pages are devoted to three supplemental uses for rotary straighteners: straightening of steel rods, the light tempering of thin-wall copper tubing, and derodding. Profusely illustrated with photos and drawings, the bulletin also presents 11 case studies that report the production performance of rotary straighteners working on a variety of pipe and tubing in both small and large metal working plants. The back cover contains basic catalog information on 13 models of the rotary straighteners. (Bulletin 55)

(2) Induction-Heating Equipment

A complete line of induction-heating equipment is described in an eight-page bulletin available from the Westinghouse Electric Corp. The high-frequency motor-generator sets and associated apparatus discussed are specifically designed for induction heating operations such as hardening, annealing, brazing, forging, and heat-treating of metals. The motor-generator sets described have standard output frequencies of 960, 3000, and 9600 cps, with power ratings of 30 to 1500 kw and higher. Electrical and mechanical specifications are included for each equipment, and construction features are discussed. (85-871)

(3) Water Reclamation

"The Treatment of Sewage Plant Effluent for Water Reuse in Process and Boiler Feed" is the title of a new bulletin published by Graver Water Conditioning Co. Fully documented and illustrated, this article examines current developments and design factors in the use of this potentially rich source of water. Typical plant layouts and result sheets are shown and discussed, important cost factors are considered, and applications and equipment are thoroughly described. (T-129)

(4) Combustion Control

Available from Hagan Corp., is a 14-page booklet explaining how automatic combustion control systems are being used with various types of gas-fired boilers. A series of pictorial diagrams show the application of control equipment as the boilers increase in size—from the simplest natural draft boiler using a parallel control system to the very large boilers needing three-element feed water control equipment and interlocking safety devices. The various components of automatic combustion control systems are also illustrated. (Bulletin MSA-116)

(5) Maintenance Aid

A bulletin published by E. F. Houghton & Co. discusses a special lubricating and rust preventing additive for use in closed water hydraulic systems. The bulletin contains complete application data, and several case history reports pointing out the benefits obtained from this additive by industrial users.

(6) Protective Compound

Available from Spraylat Corp., is a data sheet discussing a new type temporary protective coating for use on stainless steel, aluminum, copper and decorative laminate surfaces. Known as Spraylat SC-1503, the compound offers the advantage of being the lowest cost method of protection without any fire hazard or toxic condition in application or removal.

(7) Blast Cleaning

"Eight Steps to Lower Cleaning Costs," is a new bulletin published by American Wheelabrator & Equipment Corp. The various applications of abrasive blast cleaning to problems encountered both in the steel milling industries and in industries concerned with the processing of steel mill products are discussed. Included are performance data and photographs of equipment in use at particular plants. (Bulletin No. 864)

(8) Alloy Booklet

A newly revised edition of a booklet entitled, "Engineering Properties and Applications of Ni-Resist," features applications of corrosion resistant nickel alloyed cast iron. The 64-page booklet available from the International Nickel Co., Inc., tabulates the mechanical and physical properties of "Ni-Resist," and includes problem data sheets. (Bulletin A-71)

(9) Temperature Control

The recording and/or controlling of open hearth roof tempera-

tures are described in data sheets from Leeds & Northrup Co. Target brick applications in which the detector is mounted on a special brick in the roof of the furnace and direct sighting applications in which the detector sights directly through either the front or back wall of the furnace on the underside of the roof are discussed. [Data Sheets 643] (3) & (4)

(10) Rubber-Insulated Cables

Rubber-insulated cable constructions, a cost-saving cable design for use in racks or trays for applications where rigid conduit systems are either unnecessary or undesirable are covered in a new 32-page booklet published by the Okonite Co. Included in the booklet are current carrying capacities, dimensions, installation and handling techniques, splicing and terminating drawings and instructions and fittings. (1090)

(11) Shaft Couplings

Dihedral spindle shaft couplings specially designed for rolling mill service are illustrated and described in a new booklet published by Ajax Flexible Coupling Co., Inc. Included in the bulletin are detailed information and illustrations on the design which is responsible for the couplings performance under severe rolling mill service. (Bulletin No. 58)

(12) Metal Castings

A new eight-page folder published by the American Brake Shoe Co. describes metal castings for industry. The booklet describes characteristics of the material, lists properties, and carries engineering information on hardenability, section strength, and comparative properties of other cast metals. Typical applications are pictured.

(13) Gear Drives

Just published by Link-Belt Co., is a new 32-page book describing the complete line of parallel shaft gear drives. Listed are 39 standard size drives for the efficient vibration free transfer of power, together with a complete line of baseplates and built-in backstops. Single, double and triple reduction drives permit standard ratio selections from as small as 1.2:1 to as large as 323:1, with horsepower capacities of over 2000. Complete engineering data. (Book 2619)

(14) Coatings

A new bulletin on protective coatings has been published by Atlas Mineral Products Co. Included in the brochure are neoprene heavy duty, neoprene extra heavy duty, styrene, chlorinated rubber and epoxy resin based coatings. (Bulletin 7-2)

(15) Lubrication

An eight-page illustrated bulletin describing a centralized lubrication system has been issued by the Farval Corp. The booklet explains how this system works and where it can be used. Also illustrated are a complete line of fittings and accessories for lubrication requirements. (Bulletin No. 16)

(16) Pyrometer Accessories

The Bristol Co., has published a 56-page manual describing thermocouples and pyrometer accessories. The bulletin contains extensive engineering data on the selection and installation of the proper types of thermocouples, wells, head assemblies, and other pyrometer accessories, as well as recommended thermocouples for specific installations in the chemical, metalworking, iron and steel, ceramic, petroleum, food, and glass industries and many others. Numerous examples of specific recommendations for heat-treating and metal processing applications are outlined, along with the design and process considerations involved. There are 165 photos and line drawings, illustrating products, suggested installation techniques, and accessories, as well as thermocouple calibration tables. (Bulletin P1238)

(17) Grease

A silicone fluid-carbon black mixture, Dow Corning 41 Grease, designed for high temperature, slow speed bearings is discussed in a new six-page brochure published by Dow Corning Corp. Specifications and typical properties are included in this bulletin. Performance data is featured in the form of illustrated case histories detailing actual savings in relubrication schedules, replacement and maintenance costs. Applications discussed include oven conveyor bearings, dolly wheels, injection valves, permanent casting machines, extruder hold-down bolts, and turbine governors.

(18) Single-Point Presses

The Cleveland Crane & Engineering Co., has printed a new catalog covering their new line of welded steel single-point presses. Construction features of these presses and specifications are included. (No. 2019-A)

(19) Pneumatic Systems

A bulletin describing pneumatic controllers, their applications and how they work has been published by Minneapolis-Honeywell Regulator Co. Pneumatic transmission systems and cascade, ratio and other interconnected control systems are also described. Practical information is included for the plant operators on how to tune pneumatic controllers to a process, how to introduce manual adjustments and how to provide the best air supply. (Bulletin 1120)

(20) Gear Sets

A manual that aids gear selection, use, and maintenance has been issued by Foote Brothers Gear and Machine Corp. All standard gear sets available are listed by center distance and capacity to give designers the most complete and convenient selection possible to suit specific applications. In addition to illustrating and listing the line, with complete specifications, the 30-page book contains material helpful in the selection of proper gear sets. Efficient, space-saving gear arrangements are shown, and a section is devoted to gear maintenance. (Manual DR No. 2)

(21) Welding Accessories

The complete line of arcwelding and oxyacetylene welding supplies and accessories is covered in a new 36-page catalog published by Air Reduction Sales Co. Included in this booklet are welding rods, fluxes, brazing alloys, goggles, helmets, shields, electrode holders, protective clothing, cable, clamps, hose, lighters, cylinder trucks and carrying cases. (ADC 848)

(22) Air Power System

Ingersoll-Rand Co., has published a six-page booklet entitled, "A Better Air Power System." The brochure explains that power losses in compressed air lines are frequently as much as 30 to 50 per cent and describes just how to go about finding out if more air is being wasted than the repair and renovation of the distribution system would cost. The procedures to bring the system up to accepted standards are explained. Also included are the design of new systems and diagrams of different types of piping networks and tables of friction losses of air in pipe, fittings and hose. (Form 213-A)

(23) Industrial Television

Industrial television equipment is the subject of a four-page folder published by Radio Corp. of America. Features, applications and construction details on closed circuit television are illustrated and described in the folder. Also listed are specifications. (Catalog E.51)

(24) Electrodes

A new bulletin describing electrodes in detail has been issued by Ampco Metal, Inc. This bulletin lists the outstanding features of this patented electrode and gives information relative to identification, core rod, chemical composition, deposit mechanical properties, current range, welding procedure, etc. (W-26)

(25) Preheating Chart

Tempil Corp., has published a preheating chart listing in a clear, concise manner the recommended preheat temperatures for 79 commonly used metals and alloys. Factors influencing temperatures and the desirable effects of correct preheating on metal properties are enumerated. Plain carbon steels, high tensile steels, medium chrome moly steels and plain chrome steels are some of the metal groups for which approximate compositions and recommended preheat temperatures are shown.

(26) Arc Furnace Control

A four-page bulletin describing the system of hydraulically positioning arc furnace electrodes has been published by Askania Regulator Co. Included in the catalog are the advantages, operation, and installation of the arc furnace control. (No. 162)

(27) Bearing Maintenance

Available from The Torrington Co., is a 20-page booklet on bearing maintenance for metal rolling mills. Included in the booklet are subjects on bearing installation, bearing seals, lubrication, and a maintenance check list.

(28) Packings

The Garlock Packing Co., has published a complete catalog describing o-rings. The catalog gives complete design information, recommended pressures, and available materials for both dynamic and static applications. It also contains a complete list of standard o-ring sizes. (No. Ad-148)

(29) Gunning Practices

Availability of a new full color, illustrated 12-page booklet on gunning practices is annouced by Basic Refractories Inc. The brochure discusses in some detail the history, development, and current gunning procedures in open hearth and electric steelmaking furnaces; miscellaneous steel plant operations; and the foundry and copper industries. In addition to outlining the many advantages of refractory air-emplacement, the booklet also briefly traces the evolution of basic gun refractories. (G-102)

(30) Dynamic Response D-C Motors

A new 12-page illustrated bulletin describing the new super "T" line d-c motors with dynamic response has been published by Reliance Electric and Engineering Co. The booklet explains how dynamic response is the new standard performance of the super "T" motors, which was formerly found only in specially designed motors. Information is included on speed ranges, acceleration rates, enclosures, dimensions, and selection data. Photographs, diagrams, charts, and sketches help to illustrate this story of dynamic response. (No. C-2002)

(31) Batteries

C&D Batteries, Inc. has just released specification bulletins describing their complete line of lead-calcium and lead-antimony batteries for control, switchgear, and auxiliary power application. The specifications include data on battery ratings and capacities, details of design and construction, dimensions, weights, and types of containers. (CP536-Rev. 1 and CP537-Rev. 1.)

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BUSINESS REPLY CARD
First Class Permit No. 1963, Sec. 34.9, P. L. & R. Pittsburgh, Pa.

IRON & STEEL ENGINEER
1011 EMPIRE BUILDING
PITTSBURGH 22, PA

IRON & STEEL ENGINEER

Send The *free* Booklets Circled Below:

*MARCH, 1955

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29	30	31	50	51	52	53	54	55	56	57	58	59	60
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89	90	91	92										

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CITY _____ ZONE _____ STATE _____

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PUBLICATIONS CURRENTLY OFFERED by Iron and Steel Engineer Advertisers

ITEM	COMPANY	BULLETIN	DESCRIPTION
50	ADALET MANUFACTURING CO.	BULLETIN G & F	Exposion-proof junction boxes and switch fittings.
51	AEROVENT FAN CO., INC.	FOLDER D-50	Duct Fans.
52	AJAX FLEXIBLE COUPLING CO.	BULLETIN 58	Dihedral spindle shaft couplings.
53	AMERICAN FLEXIBLE COUPLING CO.	CATALOG 501 AND BULLETIN 1052	Fully crowned tooth form couplings.
54	AMERICAN WHEELABRATOR & EQUIPMENT CORP.	BULLETIN 894 AND 914	Descaling steel strip and sheet.
55	BAILEY METER CO.	SPEC. E12-5	Recorder on combustion economy and chart sample.
56	BEARINGS, INC.		SKF pillow blocks.
57	BEDFORD FOUNDRY & MACHINE CO., INC.		Mill type cranes.
58	E. W. BLISS CO.	BULLETIN 40-A	Rolling mills.
59	BUSSMANN MANUFACTURING CO.	BULLETINS FIS, HCS	Blowing time charts and hi-cap fuses.
60	DIAMOND POWER SPECIALTY CORP.		Industrial television.
61	DRAVO CORP.	BULLETIN 225	Bridges, unloaders, trolleys, and tower equipment.
62	DURABLA MANUFACTURING CO.	BULLETIN P-1	Check valves.
63	ELECTRIC CONTROLLER & MANUFACTURING CO.	BULLETIN 905	Lifting magnets.
64	ELECTRIC CONTROLLER & MANUFACTURING CO.	BULLETIN 942-B	Tab-weld plate resistors.
65	ELECTRIC STORAGE BATTERY CO.	FORM 1982	Motive power batteries.
66	ELLIOTT CO.		Mill motors.
67	FARVAL CORP.	BULLETIN 26	Centralized lubrication.
68	D. B. FLOWER MANUFACTURING CO.	BULLETIN 4-1	Precision engineered brush holders.
69	GARLOCK PACKING CO.	AD-124	Split-klozure oil seals.
70	GLEASON REEL CORP.		Reels.
71	HAGAN CORP.	MSA 114A	Pneumatic control systems.
72	HANNIFIN CORP.	BULLETIN 113	Hydraulic Cylinders.
73	C. B. HUNT & SON, INC.	BULLETIN 531	Hydraulic valves.
74	LINK-BELT CO.	BULLETIN 2416	Belt conveyor idlers.
75	LUBRIPLATE DIVISION, FISKE BROTHERS REFINING CO.		Lubrication.
76	LINTERN CORP.	BULLETIN AC-549	Aire-rectifiers.
77	LINTERN CORP.	BULLETIN P-552	Pulpit air conditioning.
78	MINNEAPOLIS-HONEYWELL REGULATOR CO.	CATALOG 1531	Control with electronic instruments.
79	MORGAN ENGINEERING CO.		Morganization.
80	MORGARDSHAMMAR	BULLETIN L3-IE	Roller guides for bar and wire rod mills.
81	NATIONAL CARBON CO.		Motor and generator maintenance.
82	OHIO ELECTRIC MANUFACTURING CO.	BULLETIN 112	Magnets and magnet controllers.
83	PACIFIC PUMPS, INC.	BULLETINS 106, 109, 118	Boiler feed pumps.
84	RADIO CORPORATION OF AMERICA		Industrial television system.
85	RELIANCE ELECTRIC & ENGINEERING CO.	BULLETIN C-2002	D-c motors.
86	REPUBLIC FLOW METERS CO.	BULLETIN 802	Low pressure instruments.
87	RUST-OLEUM CORP.		Preventive rust literature and color chart.
88	CHAS. TAYLOR SONS CO.	BULLETIN 507	High temperature silica cement.
89	S. G. TAYLOR CHAIN CO.	CATALOG 120	Alloy steel chain.
90	UNITED STATES GRAPHITE CO.		Brushes.
91	WAGNER ELECTRIC CORP.	TU-205	Transformers.
92	L. J. WING MANUFACTURING CO.	HR-6A	Revolving unit heaters.

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Electric furnace roofs at

THE TIMKEN ROLLER BEARING COMPANY

are bonded with

TAYCO-40 SILICA CEMENT

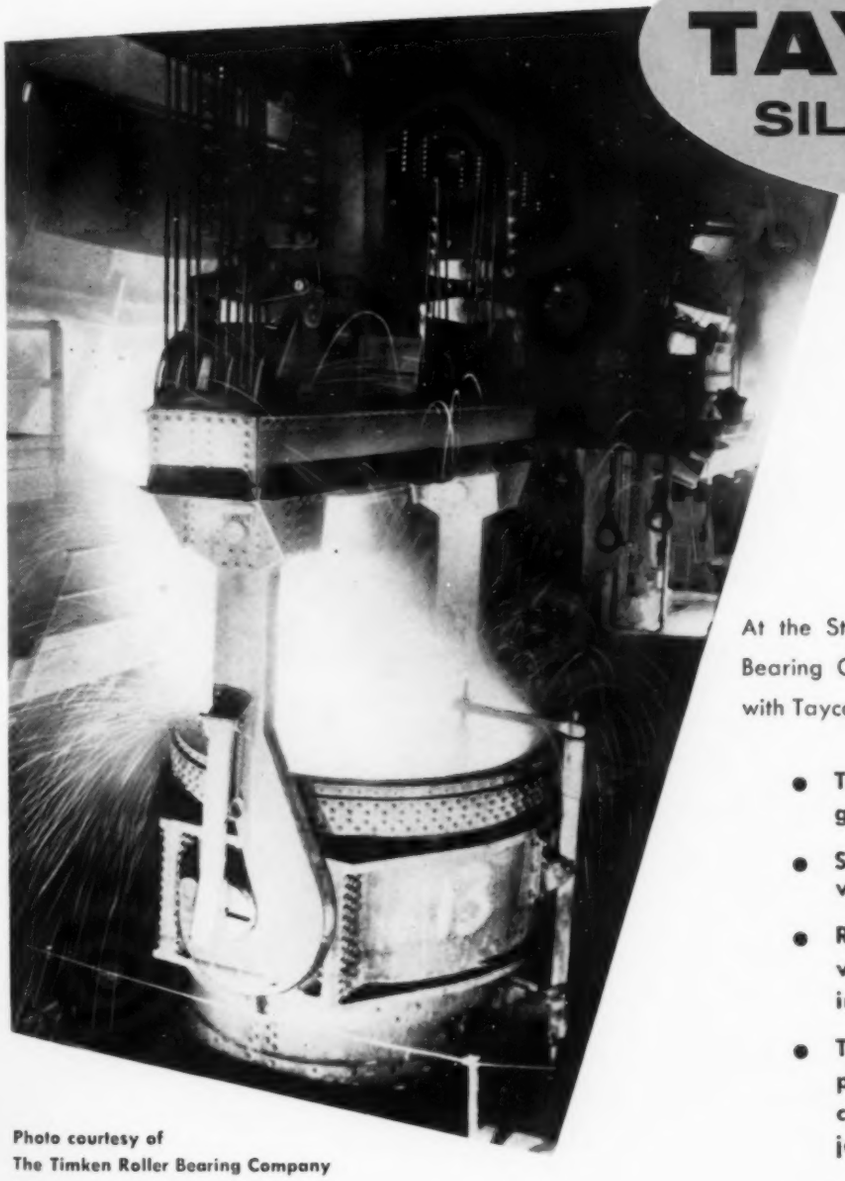


Photo courtesy of
The Timken Roller Bearing Company

At the Steel and Tube Division of The Timken Roller Bearing Company, electric arc furnace roofs are laid with Tayco-40 Silica Cement. The advantages are many:

- **Tayco-40 is nearly as refractory as the best grades of silica or super-duty silica brick.**
- **Silica brick and shapes are more easily fitted with all voids and irregularities well filled.**
- **Roof life is prolonged. Thin, tight joints prevent brick from slipping out of place when in service. Spalling is retarded.**
- **Tayco-40 has excellent water retention properties. It is the most workable silica cement obtainable. Less cement is used; joints are thinner, tighter.**

Tayco-40 is used and endorsed by superintendents of leading steel mills for lengthening the life of silica electric furnace roofs and side walls; for open-hearth furnace roofs, and all other places in open-hearths where silica brick are used. Try Tayco-40 for your next rebuild. Detailed data given in Bulletin No. 507. Ask your Taylor Field Engineer or write direct for your copy.

Exclusive Agents in Canada:
REFRACTORIES ENGINEERING AND SUPPLIES, LTD.
Hamilton and Montreal

TAYLOR ZIRCON TAYLOR SILLIMANITE

The **CHAS. TAYLOR SONS Co.**
A SUBSIDIARY OF NATIONAL LEAD COMPANY
REG. U. S. PAT. OFF.
REFRACTORIES SINCE 1864 • CINCINNATI • OHIO • U.S.A.

Catenary Furnaces

A 12,000 lbs/hour Fuel-fired Catenary Annealing Furnace for stainless strip used in line with spray quench followed by descaling and pickling baths.

FURNACE CHARACTERISTICS

Inside Dimensions	50'-0" long x 7'-0" wide x 6'-8 3/8" high
Fuel Input	1,800,000 BTU/hour
Operating Temperature Range	1200 to 2250°F
Stainless Strip	Cold reduced—annealed in gauges from 0.007" to 0.125"
Stainless Strip	Hot rolled—annealed in gauges from 0.093" to 0.200"

Three (3) zone proportioning control

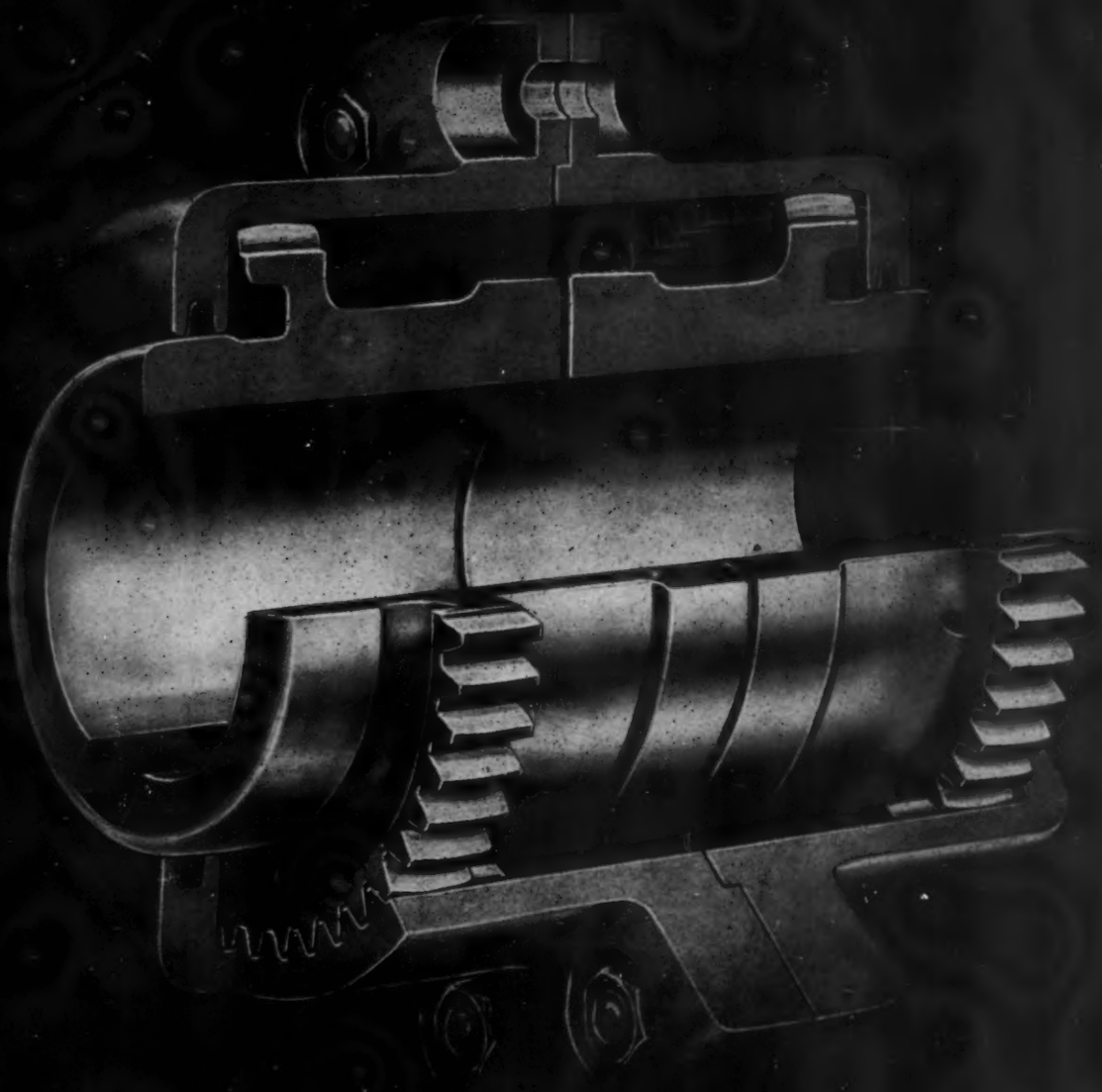
Complete control over fuel-air ratio to maintain desired atmosphere in furnace

DREVER COMPANY

RED LION RD. & PHILMONT AVE., BETHAYRES, PA.

23

POOLE



A COPY OF CATALOG GIVING FULL DESCRIPTION AND ENGINEERING DATA SENT UPON REQUEST.

FLEXIBLE COUPLINGS

POOLE FOUNDRY & MACHINE COMPANY

WOODBERRY, BALTIMORE, MD.

accurate— sensitive— trouble-free— easy to service—

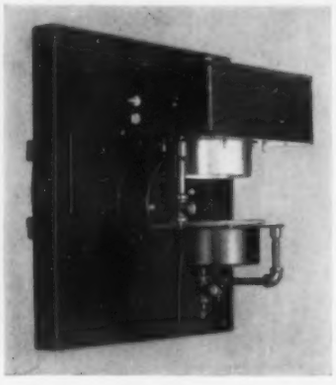
Four reasons for choosing these Republic Low Pressure Instruments to measure flow or pressure of gas and air

in

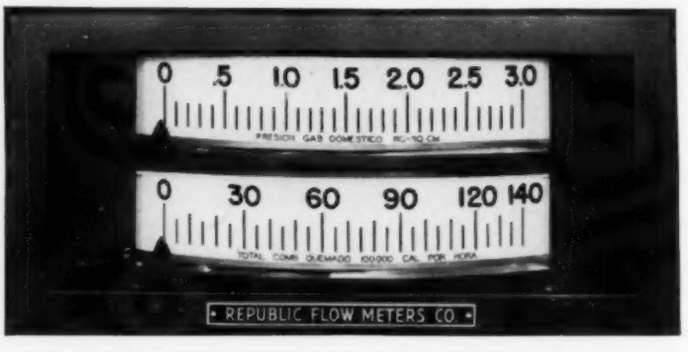
OPEN HEARTH FURNACES
SOAKING PITS
REHEATING FURNACES
COKE OVENS
SMELTING FURNACES

Republic Oil Sealed Bell Recorder at left responds to the slightest changes in furnace pressure and stack draft, and works independently of other controls. Operating principle is so simple that a minimum of maintenance is required. Sealed bell withstands high temperatures and will not crack, rupture or wear out. For pressure or vacuum measurement, the Recorder may be connected directly to a furnace or pipe line. For differentials, it may be connected across an orifice.

Recorder has ranges 0-0.2″ H_2O and 0-8″ H_2O at static pressures to 10 psi. On low range, large 4″ diameter bell gives sensitivity of ±.001″ H_2O.



For quick periodic inspection and cleaning, mineral oil reservoir at rear of Recorder may be lowered by disconnecting one pressure connection and four bolts. Calibration is not changed.



Horizontal Indicator is operated by a tough, resistant diaphragm made of polythylene plastic. Each Indicator is separate and may be individually removed or adjusted. Indicator arm swings on jeweled bearings for friction-free accuracy. Internally illuminated scales may show pressure, draft, pressure-draft combination or differential pressure. Ranges from 0-0.2″ H_2O to 0-40″ H_2O.

Two Indicators are often mounted together to read air flow—gas flow ratio in furnace firing. They may be calibrated so their pointers line up when air and gas are in the correct ratio.

Both instruments fully described in Bulletin 802. Write for your copy today.

REPUBLIC FLOW METERS CO.
2240 Diversey Parkway, Chicago 47, Illinois

Replacement costs take a plunge...when you use pickling baskets of corrosion-resistant Ampco* Metal

AMPCO Metal's high resistance to most corrosive pickling solutions means money saved for you. It means that pickling baskets stay on the job longer, when made of Ampco Metal. It means less time spent for maintenance, repairs, replacement. And Ampco Metal's toughness, coupled with its ability to withstand corrosion, means that you get long, low-cost performance all through your pickling line — from strip rollers, crates, chains, and yokes.

And there's more! Ampco Metal has remarkable wear resistance, and high impact and fatigue strength. It saves time, constant replacement costs, and expense in such applications as screw-down nuts, slippers, and flash-welder dies.

Let versatile Ampco Metal help you cut costs, improve production. Get complete details from your nearby Ampco field engineer or write us about your tough wear or corrosion problems.

*Reg. U. S. Pat. Off.

AMPCO METAL, INC. G-21
DEPT. IS-3, 1735 S. 38TH STREET
MILWAUKEE 46, WISCONSIN
West Coast Plant • Burbank, California

●designed for cutting hot steel slabs up to 7" thick by 42" wide

Operating on the 42" shear line of the U.S. Steel Corporation's Clairton Works, this tremendous 400,000 pound Lewis up-and-down Slab Shear is designed for cutting hot steel slabs up to 7 inches thick x 42 inches wide.

Designed and built by Lewis for both power and capacity, this new shear has a maximum knife pressure of 2,200,000 pounds and a combined up-and-down stroke of 13 inches. At continuous running speed, driven by a 250 hp motor, it can make 12 cuts per minute.

In addition to the shear . . . run-out tables, transfer cooling tables, and other auxiliary equipment were designed and built by Lewis.

If you have any problem involving roll mill equipment, be sure to call us. The same engineering know-how and modern manufacturing facilities are readily available to you.

BLAW-KNOX COMPANY
LEWIS MACHINERY DIVISION
PITTSBURGH 30, PENNSYLVANIA

LEWIS up-and-down cut SLAB SHEAR

BLAW-KNOX

LEWIS PRODUCTS: Two-High Mills • Three-High Mills • Four-High Mills • Strip Mills • Bar, Billet and Structural Mills • Plate Mills • Rod Mills • Coilers • Tables • Shears • Pinion Stands • Gear Drives • Roll Lathes

Equipment News...

FLOW PUMP

▲ A new line of six-in. stroke direct flow pumps for heavy duty pumping applications is available from Aldrich Pump Co.

These nine-plunger reciprocating pumps offer advantages of positive displacement, high speed operation, compact construction, interchangeability of parts, low maintenance, and minimum discharge variation.

Rated at 900 bhp, these pumps operate at speeds up to 300 rpm and have pumping capacities up to 1520 gpm, or 52,200 bbl per day. They are available with six different interchangeable fluid ends and 20 different plunger diameters. Plunger diameters range from two in. to 5¼ in. in increments of either ⅛ or ¼ in. Changes in speed and plunger sizes permit a wide range of pumping capacities, giving any desired intermediate throughput.

These pumps are suitable for drive by engine or synchronous engine-type motor. The crankshaft is located near the floor, which eliminates the need for expensive foundations to raise the driver or the need to lower the pump below floor level. The pumps feature direct flow fluid ends and inverted design for compactness and ease of maintenance. The direct flow design permits straight-line flow through the working barrel resulting in an improved volumetric efficiency and a reduction of "loss space" in the fluid end.

The design of the pump reduces to a minimum the discharge flow variation (pulsation) normally associated with reciprocating pumps. Total variation is only 2.2 per cent.

All wearing parts in the six-in. stroke series are interchangeable between triplex (three plungers), quintuplex (five plungers), septuplex (seven plungers), or nonuplex (nine plungers), except crankshaft. Because the fluid end is sectionalized in construction, maintenance is simplified and less costly.

These pumps have wide application in the metalworking, plastic fabricating, chemical processing and petroleum industries. They are used in heavy duty forging press service, die casting and extrusion, heavy duty rubber and plastic molding, large volume chemical handling, oil field water flooding, pipeline pumping and in centralized hydraulic systems.

CHART PAPER

▲ Announced by the Foxboro Co. is the perfection of a new type chart paper with special properties which improve the legibility of instrument records.

The new circular and strip charts, developed after years of testing and research, are printed under controlled humidity conditions on white sulphite sheet, meeting rigid standards of uniformity and stability. Special sizing agents have been added to permit sharp, distinct recording without "feathering."

Scale markings and time arcs are printed in a neutral gray for vivid contrast with colored recording inks. Circular charts are printed and center-punched in the same operation, holding eccentricity tolerance of less than .002 in. between hub hole and scale circles. By an exclusive process, the printing plates are produced to tolerances of .00025 in.

The charts were designed for use with new sediment-free type 1500 general purpose ink and type 316 stainless steel pens to provide a complete set of precision recording components for recording instruments.

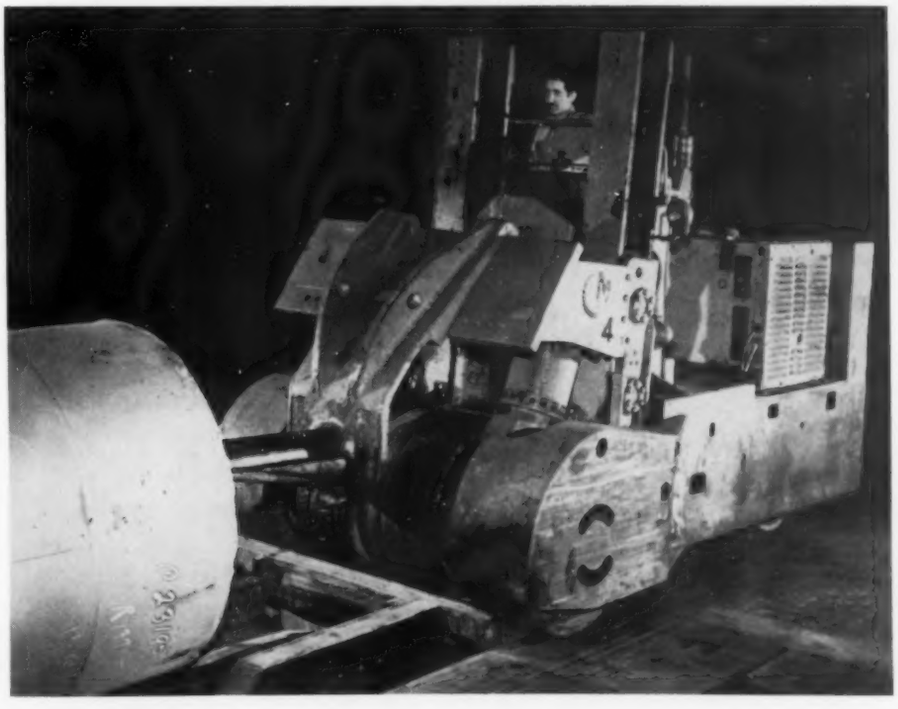
STAMPING UNIT

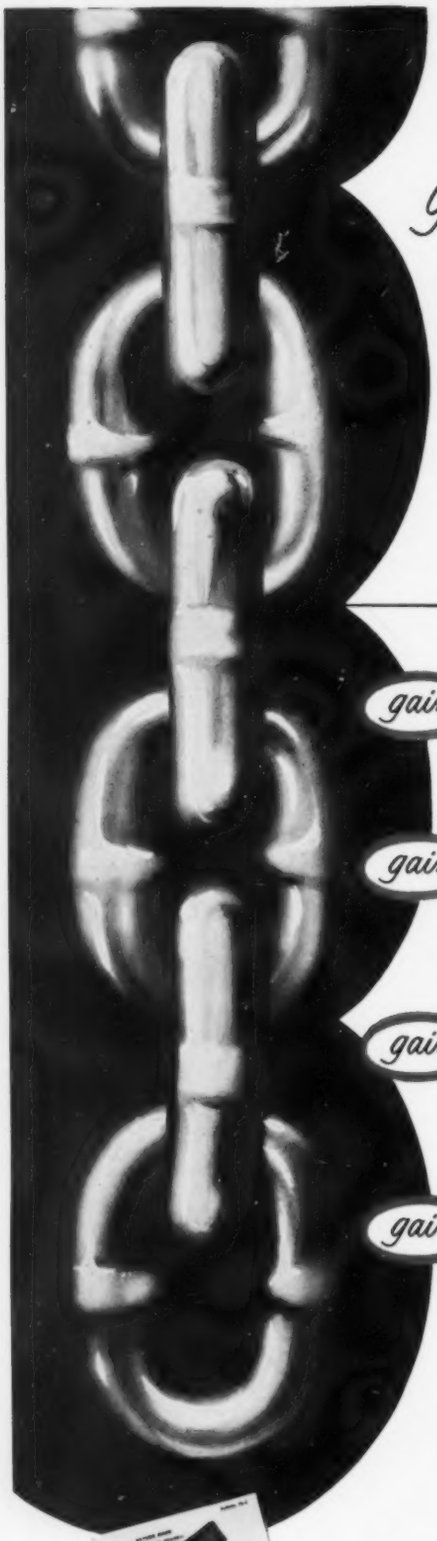
▲ Developed by M. E. Cunningham Co., is a new stamping fixture for marking around the periphery of any solid or tubular round metal part. This stamping fixture also can be adapted to marking flat parts. It will mark almost any size tubular product or up to five in. diameter solid parts.

This unit is a modification of an earlier machine which was developed for marking tubular or round parts or products. The fixture consists of four basic parts: (1) a cast steel base with side flanges for bolting to a bench, (2) a cradle or mandrel—depending on whether solid or tubular products

HEAVY DUTY TRUCK HANDLES FORD COILS

This heavy ram unit, product of Automatic Transportation Co., handles the big steel coils at Ford's Cold Rolling Mill. Known as the Automatic Skylift, the truck carries loads from 20,000 to 30,000 lb.





You're sure to gain with

TAYLOR MADE *Alloy Steel* **CHAIN!**

gain ***Extra Strength!*** It's a simple fact that Taylor Made Alloy Steel Chain has twice the tensile strength (125,000 lbs. P.S.I.) of wrought iron types (48,000 lbs. P.S.I.).

gain ***Longer Life!*** Extra strength, effective hardness (Brinell 265-285) and unusual resistance to work-hardness, shock, grain-growth and abrasion, make Taylor Made Alloy Steel Chain last five to fifteen times longer.

gain ***Added Safety!*** More and more superintendents, safety engineers and purchasing agents specify Taylor Made Alloy Steel Chain because it has twice the safety factor of wrought iron chain.

gain ***Lower Costs!*** You're sure to gain lower costs with extra strength, longer life and added safety of Taylor Made Alloy Steel Chain. And, it never requires annealing!

Repair Service! Big Savings! Send Alloy Chain and Slings to Pittsburgh or Hammond plants. We inspect, repair, test, and return them to you in first-class condition.

Contact your nearest Distributor or write: **S.G. TAYLOR CHAIN CO.**, Offices and Plant, Hammond, Indiana; Eastern Sales Office and Plant, Pittsburgh, Pa.

FREE CATALOG: Send coupon today!

S.G. Taylor Chain Co., Dept. H, Hammond, Indiana. Rush Free copy of new Catalog No. 120 giving all the facts and specifications on the complete line of Taylor Made Alloy Steel Chain.

Name_____

Address_____

City_____ State_____

TAYLOR MADE
A GREAT NAME IN
Chain SINCE 1873

are to be marked, (3) a roller marking die and (4) a gear-mounted handle. When the handle is turned, the gear arrangement causes the die to move across the piece held in the cradle or mandrel.

Cradles are used when stamping solid or heavy wall rounds. Mandrel can be supplied for stamping light wall tubular products.

The roller marking die may be either insert or solid style. Either single characters or logotypes may be fitted into the insert style dies. Type capacity depends on the size of character to be used.

BREAKER ENCLOSURE

▲ New nodular cast iron enclosures for AB-I circuit breakers in hazardous locations, has been announced by Westinghouse Electric Corp. The new material permits stronger construction while achieving a weight reduction of 45 per cent over conventional cast iron.

Wide machine-ground flanges and close-fitting operating handle mechanisms prevent internal arcs from igniting explosive or combustible atmospheres.

Covers are secured by high tensile strength steel bolts with suitable plating to make them corrosion resistant.

INFRA-RAY GAGE

▲ Industrial Gauges Corp. announces a new non-contact gage measuring red hot steel strip accurately as it travels at rates up to 2000 fpm.

This gage head may be located from 10 to 20 ft above the molten metal and yet accurately measures widths from three in. to 10 ft. Strip temperatures from 900 F to 2000 F do not affect accuracy.

Gaging is continuous. Signals are sent to the edger speed operator, and roller when width of hot strip varies from any pre-determined measurement. This eliminates trouble from "pull-down," reduces edge trim waste and order hold-back expense.

INSULATED CABLE

▲ An insulated, aluminum-sheathed cable designed for continuous operation at 150C and up to 200C under certain conditions has been developed by the Okonite Co. Available for

SLAB TURNING GANTRIES . . . *by "Shaw-Box"*

Slab Turning Gantries are another specialty in the broad "Shaw-Box" Line of steel mill cranes. Numerous outstanding mechanical advantages are contained in them. Among these mechanical advantages are a perfected ratchet device that disengages the hoisting mechanism if the load is carelessly handled preventing trolley being raised off the bridge when engaging slabs; roller guides to guide the ram and prevent swing of mast; a ram that can be removed without disturbing the operating mechanism.

In "Shaw-Box" Slab Turning Gantries — whether built to an individual mill's or A.I.S.E. specifications — you get the added advantages that come from "Shaw-Box" engineering, fine workmanship, and precision manufacturing methods. These added advantages insure crane performance which makes "Shaw-Box" Gantries, for the work they do, the least expensive cranes to buy and use.

SEND ALL YOUR INQUIRIES FOR STEEL MILL CRANES AND SOAKING PIT CARRIAGES TO "SHAW-BOX"

MAXWELL MANNING M&M MOORE INC. TRADE MARK

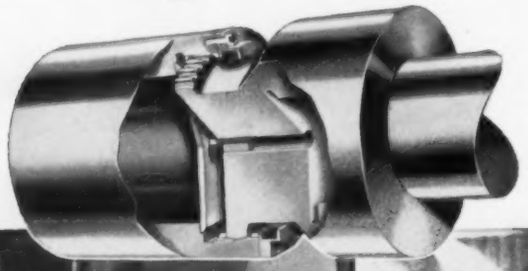
"Shaw-Box" CRANES

MANNING, MAXWELL & MOORE, INC.

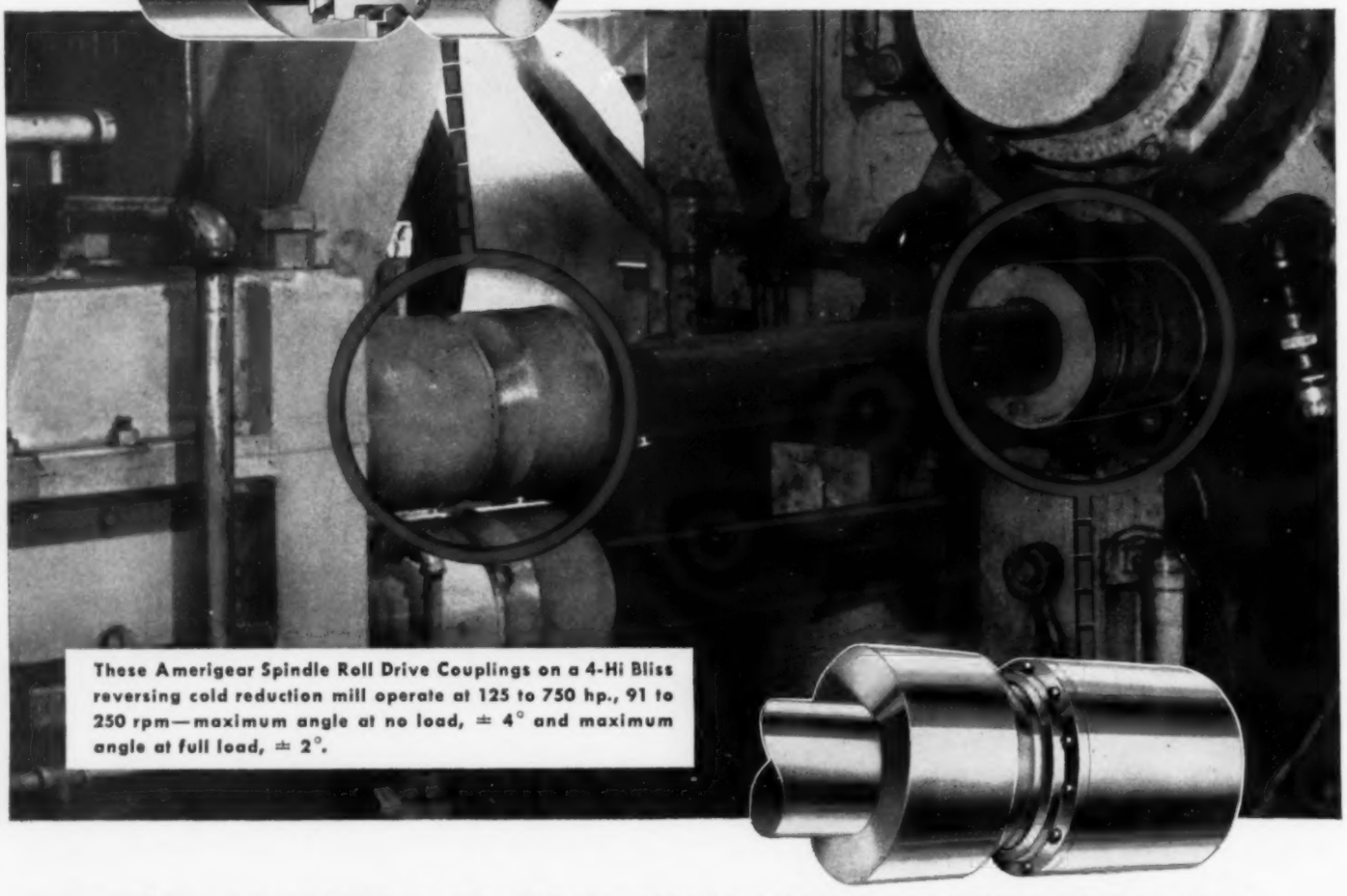
Muskegon, Michigan

Builders of "Shaw-Box" Cranes, 'Budgit' and 'Load-Lifter' Hoists and other lifting specialties. Makers of 'Ashcroft' Gauges, 'Hancock' Valves, 'Consolidated' Safety and Relief Valves, 'American' Industrial Instruments and Aircraft Products.

TROUBLED WITH "SLIPPER-TYPE" COUPLING FAILURES?
CONVERT TO
Amerigear® SPINDLE ROLL DRIVE COUPLINGS



. . . RUN LONGER WITHOUT MAINTENANCE
. . . MAKE ROLL CHANGES FASTER



These Amerigear Spindle Roll Drive Couplings on a 4-Hi Bliss reversing cold reduction mill operate at 125 to 750 hp., 91 to 250 rpm—maximum angle at no load, ± 4° and maximum angle at full load, ± 2°.

• HERE'S THE ANSWER TO YOUR HIGH MISALIGNMENT PROBLEMS . . .

Amerigear's Fully-Crowned Tooth Form concentrates the load towards the center of the tooth, eliminates tooth end and tip loading. This permits an extremely high degree of angular and lateral misalignment—up to ± 9° per engagement—with no wear or loss of power.

And By Accomodating For Roll Wear and varying distances between roll centers, Amerigear Spindle Roll Drive Couplings keep your maintenance expenses to a minimum. That's because they're precision-manufactured to transmit power to the rolls smoothly and continuously . . . even after repeated roll grinding . . . *without maintenance.*

Downtime Goes Down, Too because engaging roll end teeth are specially designed for quick assembly and disassembly. So the next time you're in need of flexible couplings for your ferrous or non-ferrous rolling mills, convert to Amerigear — a highly engineered solution to your every high misalignment problem.

Amerigear Engineers are ready to help you design improved operating efficiency into heavy presses, slitters, cranes, reels or other steel mill equipment. Write for Catalog 501 and Bulletin 1052, or attach coupon below to your letterhead.

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Amerigear ZURN INC.

AMERICAN FLEXIBLE COUPLING COMPANY
ERIE, PA., U. S. A.
IN CANADA
CANADIAN ZURN ENGINEERING, LTD.
2052 St. Catherine St. W.
Montreal 25, Que.

AMERICAN FLEXIBLE COUPLING COMPANY
ERIE, PA., U. S. A.

Please send me further information regarding AMERIGEAR COUPLINGS with the Patented Fully Crowned Tooth Form as described in Catalog No. 501 and Bulletin 1052.

Name.....Title.....
Company.....
Address.....
City.....Zone.....State.....

Please attach to your business letterhead.

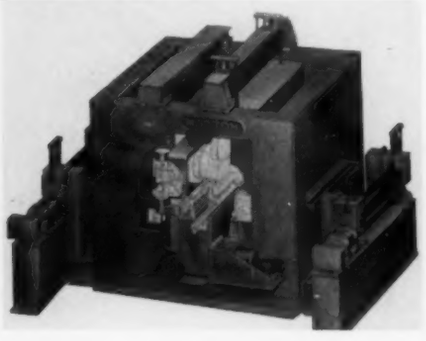
Dept. ISE-999

both power and control cable circuits, it provides an extra labor-saving advantage through its own built-in aluminum conduit.

Some of the advantages of this new insulated cable are: light weight for easy handling, corrosion resistance, high dielectric strength, space-saving small diameter, and no conduits and related "pulling-in" problems.

SHEAR-WELD-TRIMMER

▲ Morton Manufacturing Co., announces a shear-weld-trimmer specifically designed for joining the ends of coils in continuous process lines. Galvanizing, pickling, annealing, and slitting lines are a few of the many continuous processes requiring equipment of this nature.



This machine has incorporated all of the features found essential in joining coil ends from years of steel mill experience. The basic machine components are entry and exit pinch rolls, entry and exit strip centering devices, transfer carriage with independent clamp jaws, double blade up cut shear and die set, welder-trimmer unit, roller lift, and roller hold-down devices. All of the above mentioned units are contained in a single unit giving complete automation to the joining process.

DEGREASING SOLVENT

▲ A new line of degreasing solvents and cleaners has been announced by the Dacar Chemical Products Co.

Designed as replacements for carbontetrachloride and other toxic solvents, solvents 650, 600, and 350 are adaptable for metal cleaning where rapid drying and absence of film is required. These solvents are unusually low in toxicity compared to carbontetrachloride and are safe to use for metal cleaning problems.

The solvents 74-C, 45-A and 62-B, are general cleaners of the emulsifying type, and can be diluted with either kerosene or water to give a low cost cleaning solution for removing grease, oil, smut, traffic dirt, on metal parts and equipment.

LIQUID INSULATION

▲ Introduced by the Insul-Mastic Corp. of America is a resinous liquid for insulation that is sprayed like paint, but immediately foams to 20 times its original thickness.

The outstanding advantage of this new insulation is the speed at which irregular surfaces can now be insulated. Normally, it requires considerable cutting and fitting to properly place insulation around valves, fittings, flanges and other such projections. The problem of fastening the insulation in place is also troublesome. Bands, welded studs, wires, and other devices are used to hold the insulating material, and the more irregular the surface the more complex this binding problem becomes.

Known as Poly-Cell, it is said to eliminate both the fitting and the fastening tasks. Being sprayable, it can be installed wherever a spray gun can be pointed. It also will adhere of its own nature to practically any type

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NEW CASTLE PENNSYLVANIA
DIVISION OF SHENANGO CHINA, INC.

Custom made special shapes
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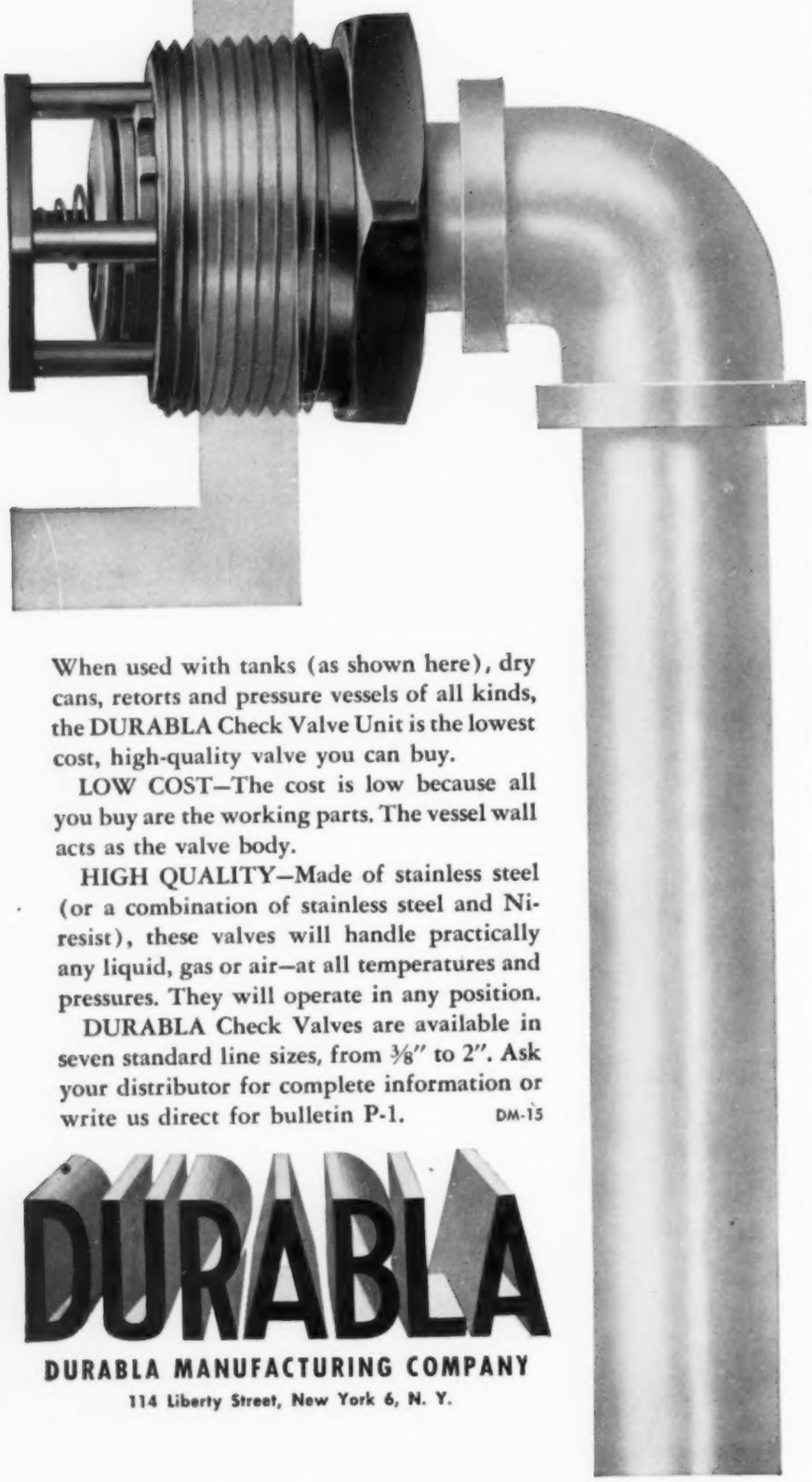
CRANKS	GLOST COMPACTS	BURNER BLOCKS
RACKS	COMBUSTION CHAMBERS	SLABS

ENGINEERED REFRACTORIES
PHONE: OLIVER 2-6661

HERE is the ideal
CHECK VALVE
for tanks and other vessels



When used with tanks (as shown here), dry cans, retorts and pressure vessels of all kinds, the DURABLA Check Valve Unit is the lowest cost, high-quality valve you can buy.

LOW COST—The cost is low because all you buy are the working parts. The vessel wall acts as the valve body.

HIGH QUALITY—Made of stainless steel (or a combination of stainless steel and Ni-resist), these valves will handle practically any liquid, gas or air—at all temperatures and pressures. They will operate in any position.

DURABLA Check Valves are available in seven standard line sizes, from ⅜" to 2". Ask your distributor for complete information or write us direct for bulletin P-1. DM-15

DURABLA

DURABLA MANUFACTURING COMPANY
114 Liberty Street, New York 6, N. Y.

of clean, dry surface. It will adhere equally well to moist surfaces.

It is sprayed as a liquid and at first it resembles a heavy coat of varnish. After a few minutes, however, it has swollen to a thick, airy cushion. After 15 minutes the foaming action has ceased, leaving a normal looking semi-rigid insulation.

It can be applied at any desired thickness in one coat. Accomplishing this is merely a matter of varying the amount of liquid originally sprayed. A little practice, it is believed, will soon enable the applicator to judge the correct amount to be sprayed for any specified thickness. Its most economical thickness is ½ to one in.

CRANE TROLLEY

▲ A heavy duty, mill type crane trolley for handling long, heavy materials that require two hooks, has recently been developed by Northern Engineering Works.

This unit is furnished with a heavy, one-piece welded steel frame supporting the load and the machinery. A feature of this trolley is the oil tight construction of the hoist gear cases which enclose all of the operating mechanism.

The trolley is furnished with mill type motors, heavy duty electric brakes and limit switches. Heavy duty roller bearings and hardened steel gears are used throughout. Operation of all motors is through full magnetic control located on the crane bridge.

ISOLATED PHASE BUS

▲ A new and improved isolated phase bus for all current ratings up to 10,000 amperes and voltages to 34.4 kv, has just been announced by Delta-Star Electric Div., H. K. Porter Co., Inc.

New telescoping covers save time in opening the bus for inspection or maintenance. All longitudinal gaskets, all supporting ring gaskets and cover bolts normally employed are eliminated. Longitudinal sections six to eight ft long can be preassembled and shipped in lengths as large as customer's facilities can handle. All preassembled conductor joints are prewelded.

Sliding a retaining ring and ring gasket moves the cylindrical inspection cover out of the way. This opens

IN THE STEEI INDUSTRY, TORRINGTON *Bearings are used extensively on work rolls, back-up rolls and for many auxiliary applications such as drives, pinion stands, coilers, etc.*

TORRINGTON Work Roll Bearings

produce tonnage records because in every detail of construction they are designed for long, heavy-duty service

Every TORRINGTON WORK ROLL BEARING is made of the finest quality, electric furnace alloy steel—carefully heat treated to provide toughness, hardness and long life. Steep angle construction guarantees high thrust capacity. One-piece, cast-bronze cages . . . with machined pads in each roller pocket . . . reduce wear, cut down-time, help keep production rolling smoothly.

Specify TORRINGTON and get more tonnage from your mill. TORRINGTON WORK ROLL BEARINGS—both two-row and four-row—are standard in a wide variety of sizes.

THE TORRINGTON COMPANY
South Bend 21, Ind. Torrington, Conn.

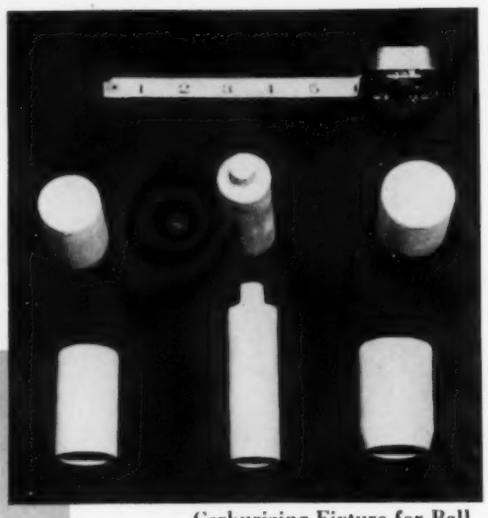
District Offices and Distributors in Principal Cities of United States and Canada

TORRINGTON TAPERED ROLLER **BEARINGS**

Spherical Roller • Tapered Roller • Cylindrical Roller • Needle • Ball • Needle Rollers

Small

HIGH ALLOY
CASTINGS

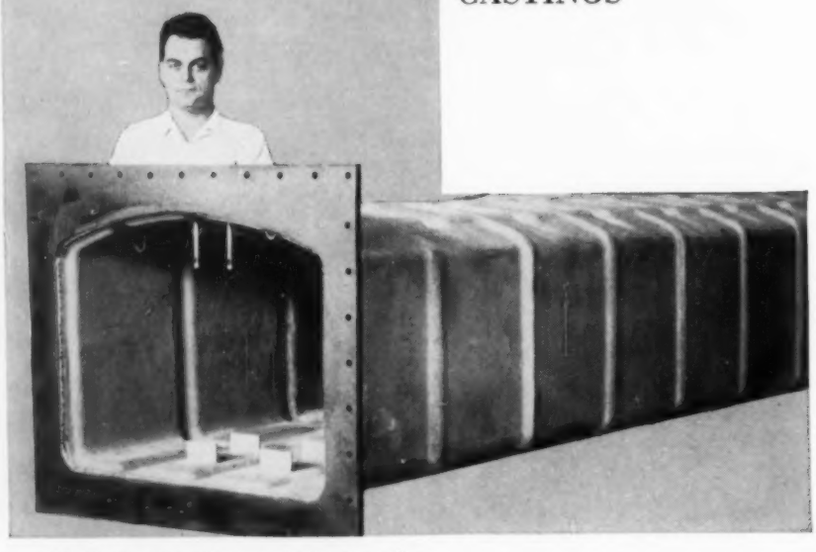


Carburizing Fixture for Ball Bearings 1½" diameter—
Analysis 35% Ni — 15% Cr

DURALOY

Large

HIGH ALLOY
CASTINGS



Muffle for Continuous Strip Annealing
12' 6" long — Analysis 38% Ni — 18% Cr.

LARGE or small DURALOY, can do it! These are just typical examples of the work moving through our foundry. Some of these castings are designed for heat resistance, some for corrosion resistance, some for abrasion resistance; all are cast by experienced foundrymen. All are carefully tested in our up-to-date laboratory.

If you have a high alloy casting problem . . . LARGE or small, we can help you. For more information, send for Bulletin No. 3150-G.

THE DURALOY COMPANY
OFFICE AND PLANT: Scottdale, Pa.
EASTERN OFFICE: 12 East 41st Street, New York 17, N. Y.
DETROIT OFFICE: 23906 Woodward Avenue, Pleasant Ridge, Mich.
CHICAGO OFFICE: 332 South Michigan Avenue

a 2½ ft section for inspection of conductors, splices and supporting insulators.

EMERGENCY BATTERY

▲ Electric Storage Battery Co.'s plastic-cased battery, type 3-COE-7, has been approved by Underwriters Laboratories, Inc., for use in emergency lighting-unit equipment.

Eight to 12 years of useful life is anticipated for the battery according to Exide. Quarter-inch-thick pasted type positive plates and active material of special formulation contribute substantially to this extraordinary long life. Negative plates of heavy, rugged construction are in balance with positive plate characteristics. The active material is locked into both plates by a series of strong horizontal and vertical grid members. This construction assures permanent contact between active material and the grid structure carrying the electrical current. These features provide exceptionally low internal resistance which increases useful service life and sustains high capacity.

Long and trouble-free life also is assured by use of double insulation of microporous rubber and Vitrex retainers, both impervious to action of the electrolyte. Low internal resistance resulting from the dual insulation assures full rated discharge characteristics.

Polystyrene, a tough, transparent and heat-resistant plastic, was chosen by the engineers as best to meet their rigid requirements for the case of the battery.

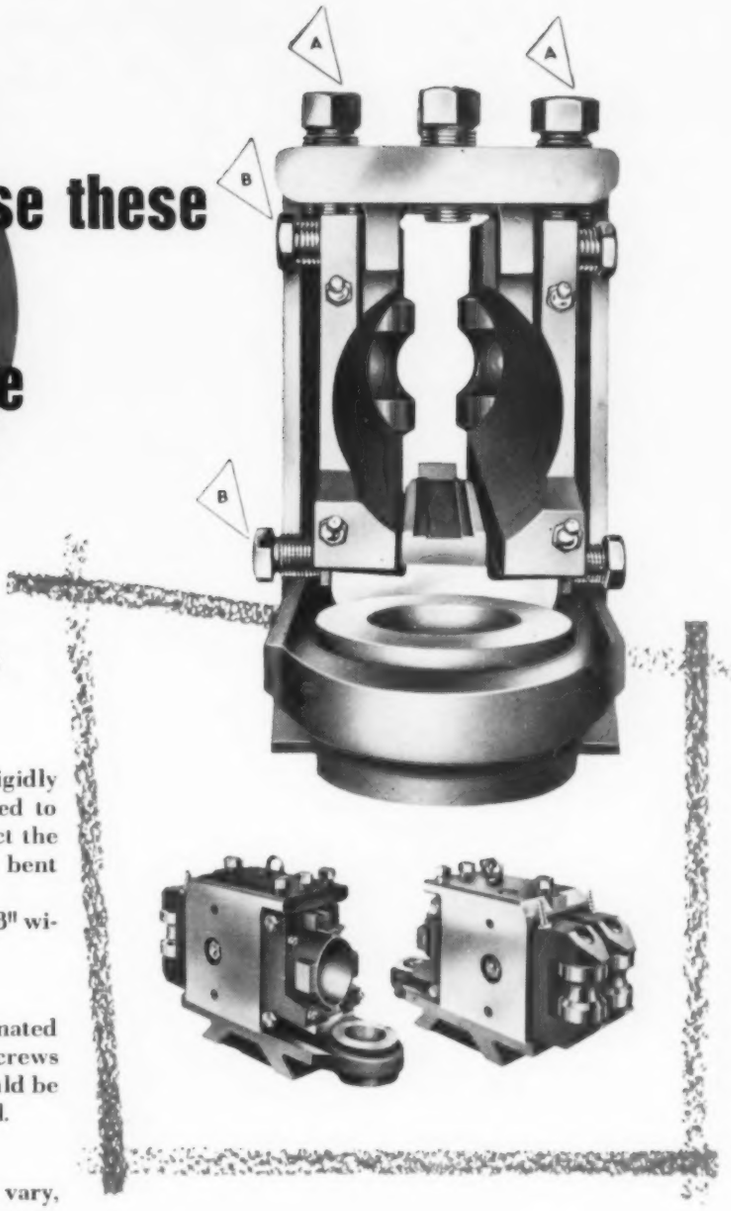
State of charge is indicated by colored pilot balls floating in a vertical channel molded into one corner of the container. According to the company, the pilot balls may be observed from distances up to 30 ft.

The battery requires addition of water only once or twice a year under normal circumstances.

While the battery has a range of capacities from 10 to 30 amp-hrs., the same design features have been applied to batteries up to 100 amp-hr capacity in three-cell units and up to 660 amp-hr capacity in single-cell units.

Similar batteries are used by electric utilities, railroads, laboratories, industrial plants, municipalities, hospitals, communication centers, offices, banks and other public build-

8 good reasons why you should use these ROLLER GUIDES in your bar or wire rod mill



The Morgårdshammar Roller Guides — patented in most countries of industrial importance — are constructed according to the following principles:

1 The entry friction guides are rigidly clamped into the guide box. They are intended to lead the oval to the groove in the roller, to protect the rollers against overloading, and to straighten bent rods.
The groove in the entry guides is made about 1/8" wider than the oval.

2 The rollers are mounted on laminated springs, which can be adjusted by means of the screws "B", and hold the oval steadily even if there should be some slight variation in the thickness of the oval.

3 If the thickness of the oval should vary, the springs of both rollers yield an equal amount, so that the oval remains in the centre of the groove.

4 To tilt the oval, the screws "A" are adjusted as shown by the arrows. One roller will then be lifted as much as the other is lowered.

5 As the oval is held very rigidly, the leader oval for wire rod may be plump, unless other circumstances call for a thinner oval.

6 The roller guide assemblies are narrow, and all screws that require adjustment during rolling are accessible from the front of the mill. No lateral space outside the guide box is therefore required for gaining access to the set screws, and the guide box assembly can thus be located close to the mill housing.

7 As the groove in the entry guides is wide and nothing but rolling friction acts on the oval, the latter is very easily introduced into the pass, and there is practically no risk of scratching the bar.

8 The roller guide may be used not only for leader and break-down oval passes but also for edging flats as well as for rolling squares, hexagons, octagons and various other sections, for instance in reduction passes for hexagon. It is suitable for all types of rolling mills. An important advantage is that the roller guide enables repeaters to be used in rolling plump leader-ovals.

P.S. Practically speaking, every bar and wire rod mill in Scandinavia uses roller guides of our design.

MORGÅRDSHAMMAR

MORGÅRDSHAMMARS MEK VERKSTADS AB • MORGÅRDSHAMMAR • SWEDEN

For the complete story — send for your copy of bulletin L3—1E.

Telegrams: Morgårdshammar, Ludvika
Telephone: Ludvika (0240) 71100

pioneering developments keep WHEELABRATOR® first in blast cleaning

8 Steps to Low Cost Cleaning of Steel Mill Products

Wheelabrator Mechanical Cleaning SAVES Time and Money—Eliminates Acid Handling and Disposal Problems

If you have any of these finishing problems, Wheelabrator Mechanical Cleaning can save time, money and space and improve your operations:

1. Ingot Mold Conditioning
2. Slab and Billet Conditioning
3. Continuous Strip Descaling
4. Sheet Descaling
5. Bar Stock Descaling
6. Wire Rod Descaling
7. Steel Shapes Descaling
8. Etching Mill Rolls

New developments in Airless Wheelabrator blast equipment and abrasives have eliminated all past objections to blast cleaning with an attendant reduction in costs. These have been proved lower than present pickling costs by the many Wheelabrator installations on all types of steel products.

With the Wheelabrator, scale is uniformly and economically removed leaving a surface ideal for cold rolling, cold forming, cold drawing and final finishing such as galvanizing or painting. By eliminating completely or partially the use of acid pickling, the Wheelabrator can equal or better your present costs without any virgin metal loss and with complete recovery of all scale as well as the abrasives used in its removal. Acid disposal problems are eliminated.

These impressive savings are being effected for steel producers and fabricators alike. Rome Cable Corp., for example, selected Wheelabrating for descaling steel strip because it was the only process that would remove surface scale economically and permit the rest of the plant to maintain its high production without requiring a major portion of its plant area.

Write today for complete information on this modern method of steel finishing for your problem.

Bulletin 894 describes the descaling of Steel Strip and Bulletin 914 describes the descaling of steel sheets. Send for your copies today.

American
WHEELABRATOR & EQUIPMENT CORP.
396 S. Byrkit St., Mishawaka, Ind.

Wheelabrator®
AIRLESS BLAST CLEANING

ings requiring emergency lighting and stand-by power. Switchgear and relay actuation, radio and TV circuits, signal control circuits for alarm systems, supervisory control of manufacturing operations and railway signalling are some of the many applications of the battery.

PNEUMATIC RECEIVER

▲ Manufactured by Bailey Meter Co. is a pneumatic receiver for instrument and control systems in power and process plants. Unlimited record

grouping, shelf-to-operation simplicity, and drift-free stability are claimed for this instrument.

Arbitrary mounting of one to four identical units is made possible by plug-in, pin-positioned construction and a unique, index drive arm. Signals may be graphically recorded in any combination from any make pneumatic transmitter with 3-15 psig or 3-27 psig ranges.

The receiver is factory calibrated to less than $\pm \frac{1}{2}$ per cent of range span and sensitive to signal changes of .01 psi. Ambient temperature changes between 30 F and 130 F are automatically compensated by an isoelastic spring.

STEEL MARKING INK

▲ A new ink for printing steel sheet products has been developed by the Pannier Corp. This ink is made in various colors, all of which have been tested in a number of steel plants with excellent results. It has withstood tests in a weathermeter machine for a period of more than 840 hours which is equal to 840 days out in the weather.

The ink has also been tested on Pannier's new drum printer which gives a complete coverage of impressions in quick drying time (15 to 20 seconds) at a speed of over 400 fpm. This time can be varied depending on customer's requirements, either longer, or shorter periods.

The ink is used in drum printing machines either in open fountains or with plate adjustment in control fountains. It also can be used by hand on automatic stamping pads. It is also supplied in paste form for use in paste form fountains.

Results have been achieved on galvanized, stainless steel sheets and other metal alloys. Also on hot and cold bars, cold rolled sheet plates. Even if products have a slight film of oil on material, the results are good and the ink will not rub off under ordinary handling treatment.

FIRE BRICK

▲ Introduced by the Robinson Clay Product Co. is a new line of refractory fire brick.

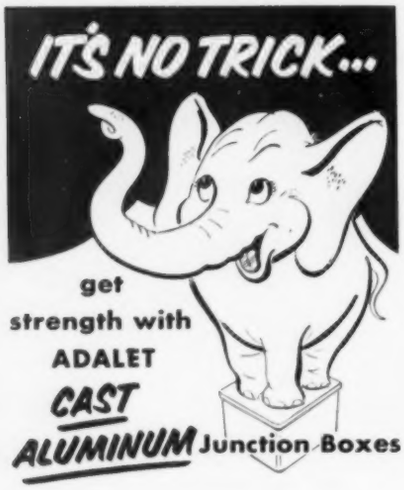
Available in three heat-duty classes, the line is made of carefully selected and tested clay and manufactured by the de-aired, extruded, and repressed process. The fire brick is high in strength and low in porosity to resist acid, slag and abrasive conditions.

"Flintex S. M." super-duty fire brick can be specified for furnace linings of all types. "Robinson S. M." has physical strength in the high-heat-duty temperature ranges. For low-heat-duty applications, "W. W. Co. S. M." may be used for a back-up brick in all types of industrial furnaces.

CONTROL UNIT

▲ A new control initiating instrument has been announced by General Electric Co.'s Instrument Department. To be installed on switchboard or panel instruments, it is an automatic, all-electrical device for initiating action when a predetermined value is reached.

In operation, the system electrically picks up the signal from the instrument pointer which eliminates the disadvantages of mechanical contacts, according to company engineers. Because control of important variables is automatic, human errors and expenses are reduced.



For any junction box installation, where STRENGTH . . . plus lightweight and weather-proof construction . . . is important, look to Adalet for:

Flanged, Flush Type

Recessed Cover, Flange Type

Unflanged, Surface Type with pads and mounting lugs

Available in a wide range of standard and special sizes, Adalet cast aluminum junction boxes are drilled and tapped to your specifications.

Write for Bulletin G and also Bulletin F describing Explosion-Proof Junction Boxes and Switch Fittings.

THE Adalet MFG. CO.
14300 LORAIN • CLEVELAND 11, OHIO

Typical applications for the new instrument are: (1) to sound an alarm when the controlled temperature reaches a critical value; (2) to initiate control to contain cycles per second within a specified range; (3) to shut down equipment at a maximum vibration point, and (4) to shut down machinery drawing more than normal power.

The new control instrument is suitable for one-set point or two-set point initiation. The load relay supplied is rated at 120/240 volts, 10/5 amps, single pole double throw.

The company has announced that GE service shops, which normally repair electric instruments, can modify customers' switchboard instruments to incorporate the standard control initiation feature without affecting their accuracy.

HIGH-STACK TRUCK

▲ For stacking operations where a high lifting height is required but, because of narrow aisle operation, a "walkie" truck is necessary, Lewis-Shepard Products, Inc., has available an electric-powered truck with a double telescopic mast.

With this mast it is possible to stack a 6000 lb load to a height of 100 in. Designed for maneuverability and ease of handling, the platform type unit is only 26 in. wide at its base and can right-angle stack in aisles only six ft wide.

Articulated linkage and stabilizing casters assure added stability for high stacking operations, easier steering and uniform traction over rough floors. The truck is equipped with a "deadman" type electric brake which insures safe instant braking even on grades with a load.

All controls, including the brake, are located in the handle head. Controls operate with handle in full vertical position—an important feature which saves aisle space and allows the truck to operate in the most confined areas.

CLEAN-UP BUCKETS

▲ Ore clean-up buckets, built by Blaw-Knox Co. for use on U. S. Steel's South Works, have two important design features. First, they open to a length of 20 ft, yet have a closed length of only 6½ ft. This closed length makes it possible to

LUBRIPLATE
No 630-AA
IS PRACTICALLY
A UNIVERSAL
LUBRICANT
—says
THE SPOKANE PORTLAND CEMENT CO.

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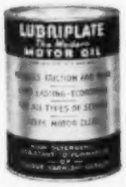
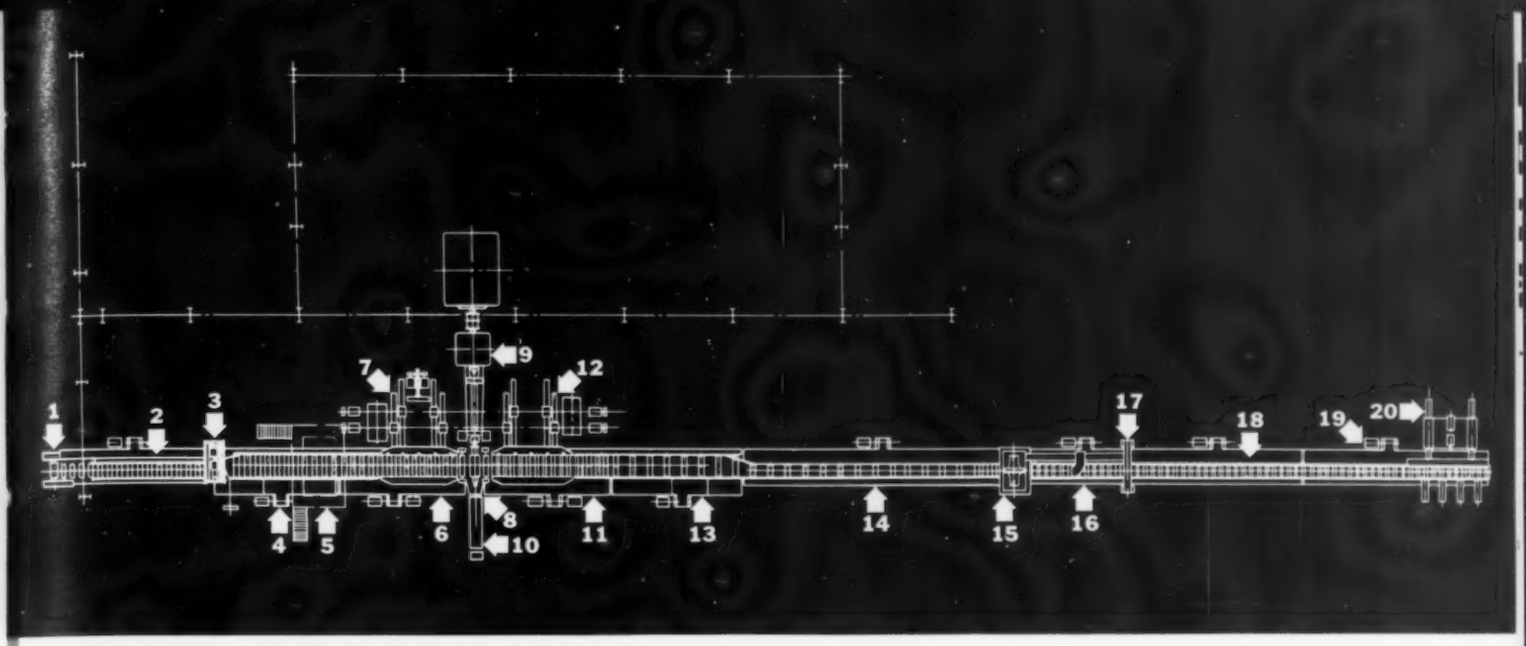
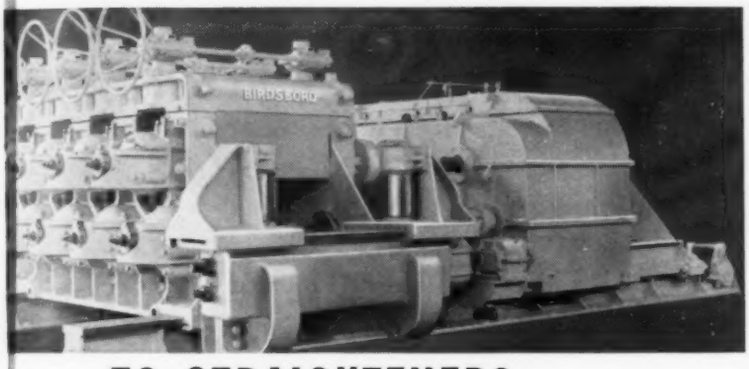
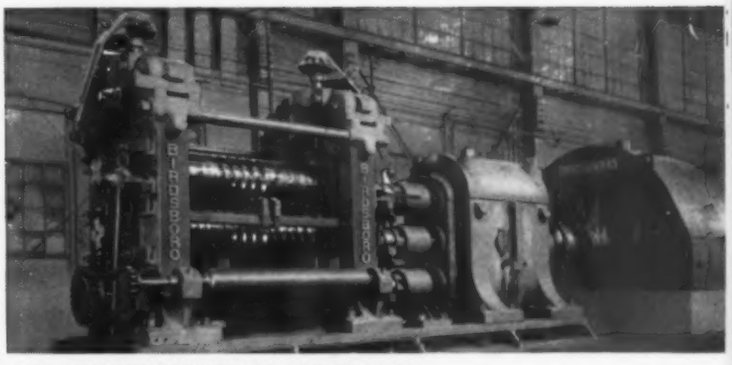


For nearest LUBRIPLATE distributor see Classified Telephone Directory. Send for free "LUBRIPLATE DATA BOOK" . . . a valuable treatise on lubrication. Write LUBRIPLATE DIVISION, Fiske Brothers Refining Co., Newark 5, N. J. or Toledo 5, Ohio.

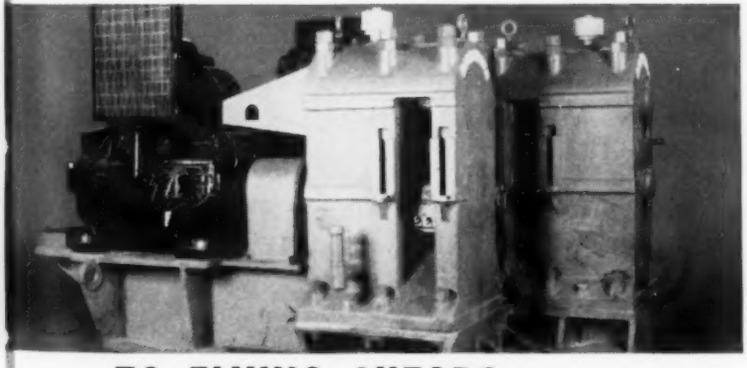


FROM COMPLETE MILLS . . . such as this 32" blooming mill layout





TO STRAIGHTENERS . . . . . TO ROUGHING MILLS



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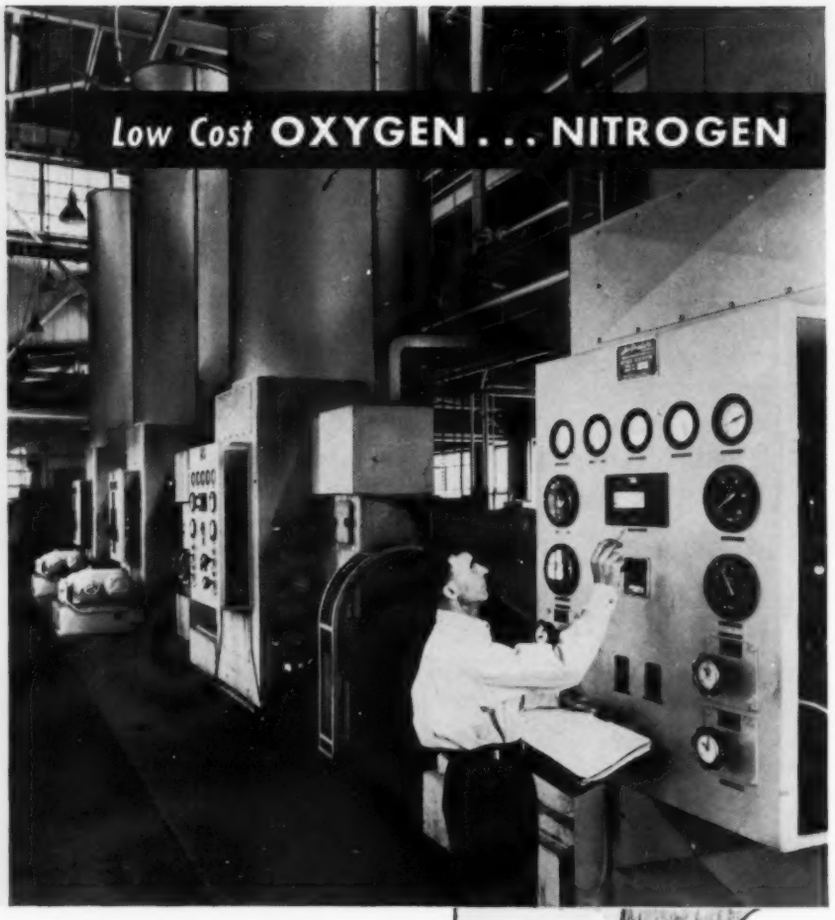
REDUCE STEEL-MAKING COSTS

with abundant oxygen produced "on location"



Oxygen is in such demand for steel-making that in-plant production has become an economic necessity.

The most practical solution to the problem of providing abundant, low-cost quantities of oxygen is an Air Products Multiple Generator Lease installation. It saves many thousands of dollars per year on current oxygen requirements of steel companies. In addition it supplies ample surplus oxygen for experimental purposes such as top blast conversion, flame enrichment, desiliconizing, decarburizing, hot top heating and other research aimed at technological improvement.

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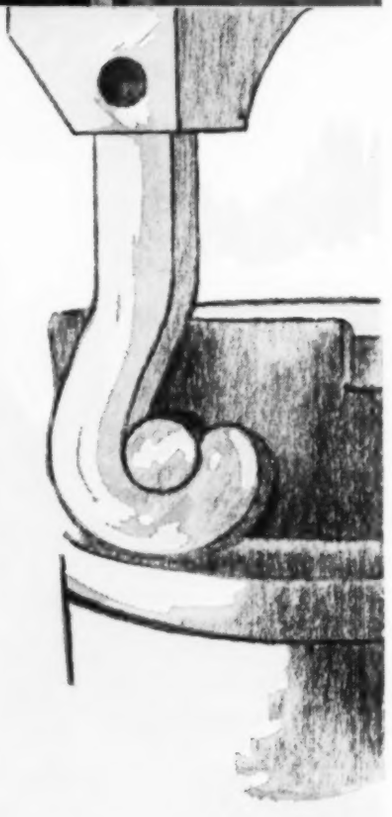
More than 100 Air Products engineers are at your service.



Air Products
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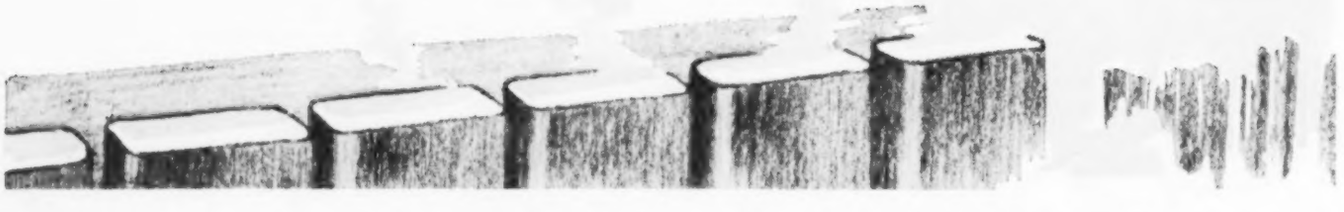

lower the bucket through the narrow hatch openings.

Under the deck the jaws can be opened to a maximum spread of 20 ft, which in combination with the 10½ ft jaw width provide an overall clean-up area of 21 sq ft.

A second feature of the bucket is its relatively low height of 15 ft when closed. Movable unloaders are designed for a minimum overall height and there are definite advantages in having clean-up and digging buckets stored on the unloader. Due to the limitations imposed by the available headroom space for storing the buckets on the unloader, the clean-up buckets were designed for a closed height of only 15 ft so both digging and clean-up buckets are readily available for interchangeable operation.

Each bucket has a nominal rated capacity of 20,000 lb when handling iron ore weighing 150 lb per cu ft. The weight of the empty bucket is 25,000 lb.

HARD WATER BYPASS

▲ Graver Water Conditioning Co., offers a hard water bypass for zeolite softeners. This system controls the proportionate mixing of untreated hard water and treated, fully-softened water to produce whatever degree of hardness is desired.

Operation is extremely simple. Only a single setting need be made to regulate the ratio of hard water to soft. Valves are automatic and adjust rapidly and surely to flow variations of one to four, without any perceptible loss of accuracy. There are no pumps and there is a minimum number of moving parts.

Book Reviews . . .

"The American Standard National Plumbing Code" was published by the American Society of Mechanical Engineers with the co-sponsorship of the American Public Health Association. The Code, containing 186 pages, is available at $3.50 per copy from The American Society of Mechanical Engineers, 29 West 39th St., New York 18, N. Y. or from the American Standards Association, 70 East 45th St., New York 17, N. Y. This publication presents a uniform code for plumbing and is designed to modernize existing practices and to coordinate the work of plumbing equipment manufacturers, architects, contractors, municipal lawmakers, building officials and others. The code may be used by architects and contractors in the design and installation of plumbing equipment, by plumbing equipment manufacturers and by states and cities as a basis for regulation and ordinances.

▲ **"Materials of Construction,"** by Adelbert P. Mills has just been published in a sixth edition by John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. The book contains 650 pp., 6 × 9-in., cloth bound and sells for $7.50. This widely used book has been expanded by 15 per cent in order to present the latest data available. New topics in this sixth edition include a chapter on service requirements of metals cover-

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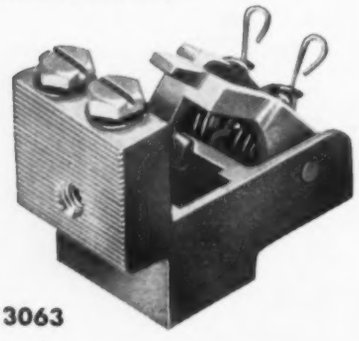

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ing developments in progressive fracture under repeated stress; constitution of metals are amplified with particular attention given to modern developments in steel, alloy steels and light-weight non-ferrous alloys. A complete new chapter on mineral aggregates has been added and classifications of structural-clay products are revised to conform with present day practice. Book also includes chapters on organic protective coatings and organic plastics.

▲ **"Tool Steel Handbook,"** written and printed by Allegheny Ludlum Steel Corp., contains 195 pp, 7¼ × 10½-in., and is cloth bound. This handbook presents compactly a relatively complete picture of the Allegheny Ludlum tool steels, their properties and treatments and the special forms in which they are available. Data is given through charts and tables. There is also an extensive discussion of heat treating and handling techniques as applied to tool and high speed steels and a complete set of weight tables and other useful reference material.

▲ **"Glass Reinforced Plastics,"** edited by Phillip Morgan, M.S., was published by Philosophical Library, Inc., 15 East 40th Street, New York 16, N. Y., 248 pp, 6 × 10 in., cloth bound, $4.75. This book was written to gather together essential facts on this many-sided subject, such as organic chemistry, design, molding processes and the major applications. The chief resins used for bonding glass fibres and their use with glass are described. Major fields of application at present are automobile, aircraft and boat-building industries, and detailed information on each is given.

▲ **"Machine Shop Operations and Setups,"** by Harold W. Porter, Charles H. Lawsche and Orville D. Lascoe, 397 pp, 5½ × 8½-in., cloth bound was recently published by American Technical Society, Chicago, Ill. This book was designed to meet the specific requirements of modern instruction in machine shop techniques. The authors have incorporated new widely-used operations into this text and have omitted the out-of-date practices. Instruction covers equipment such as measuring tools, lathes, shapers, milling machines, drill presses, and grinding equipment.

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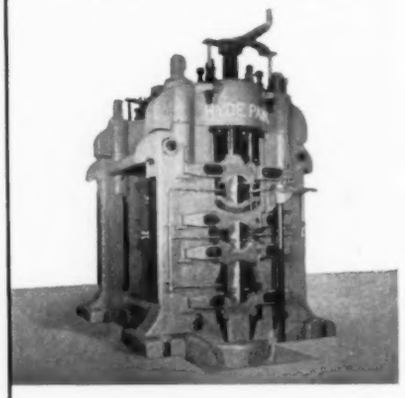
For more than 50 years Hyde Park Steel Mill equipment has been helping American industry lead the world—equipment such as—



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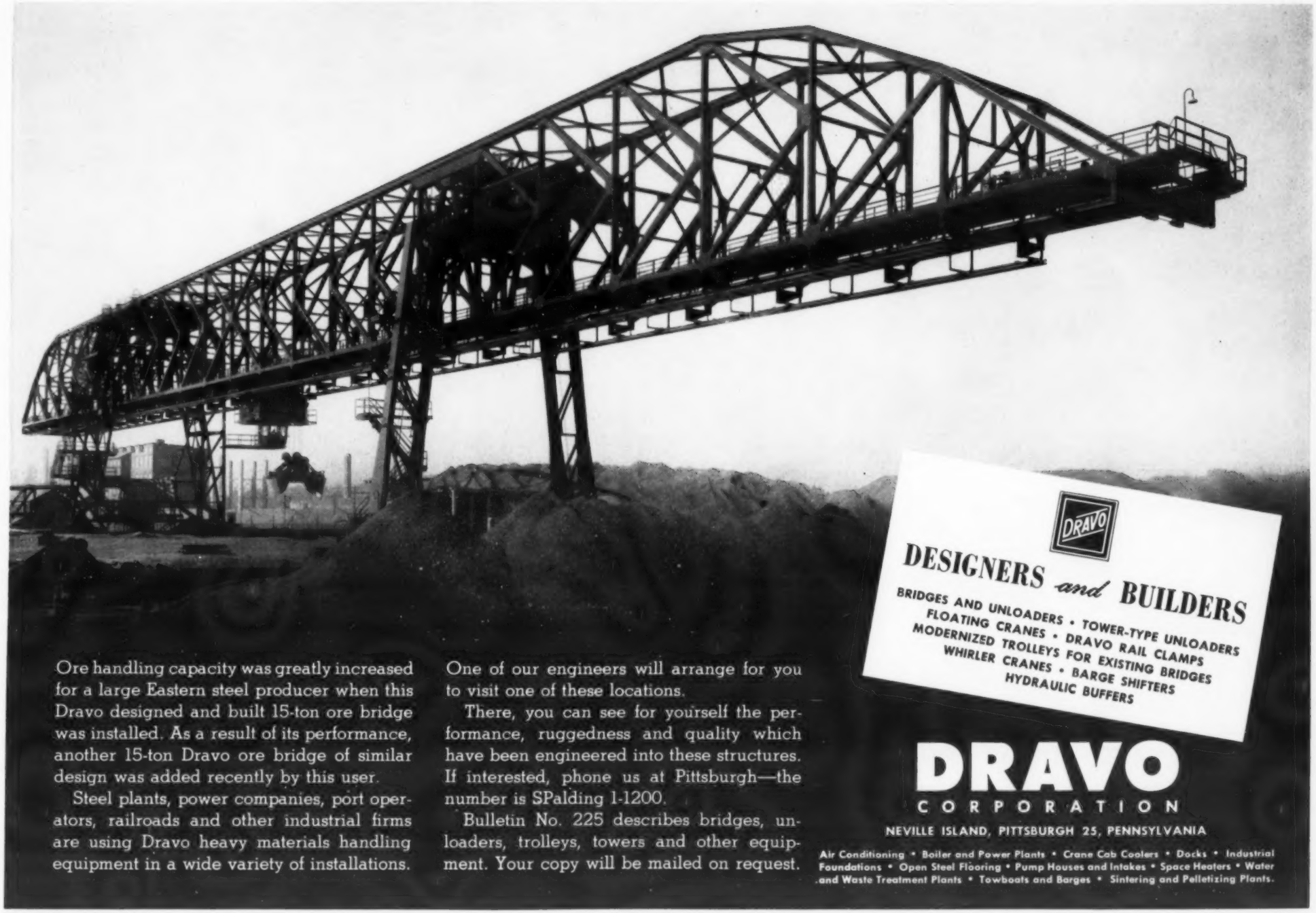

Ore handling capacity was greatly increased for a large Eastern steel producer when this Dravo designed and built 15-ton ore bridge was installed. As a result of its performance, another 15-ton Dravo ore bridge of similar design was added recently by this user.

Steel plants, power companies, port operators, railroads and other industrial firms are using Dravo heavy materials handling equipment in a wide variety of installations.

One of our engineers will arrange for you to visit one of these locations.

There, you can see for yourself the performance, ruggedness and quality which have been engineered into these structures. If interested, phone us at Pittsburgh—the number is SPalding 1-1200.

Bulletin No. 225 describes bridges, unloaders, trolleys, towers and other equipment. Your copy will be mailed on request.

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OIL SEALS

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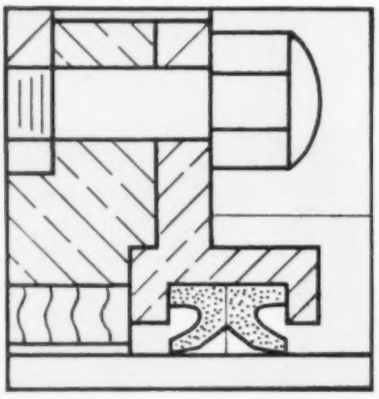
The 45,000 ton tanker, "World Glory," built at Bethlehem Steel's Quincy yard, is the largest ever built in the Western Hemisphere. The rudder stock bearings, upper and lower pintle, are protected by Split-KLOZURE Oil Seals.



Cross section shows the dual opposed Split-KLOZURE assembly on the rudder post of the "World Glory." This dependable, easy-to-install seal keeps vital lubricants *inside* the rudder trunk's voids, keeps seawater *out*.

*KLOZURE is a registered trademark for Garlock oil and grease seals.

The construction of the Garlock Split-KLOZURE* permits easy and quick application in inaccessible locations. Instead of applying over the end of the shaft or journal—as is necessary with solid, one-piece seals—the Split-KLOZURE is placed *around* the shaft or journal. This can be done at any convenient place near the bore or housing into which the seal is to be applied.

Thus, the installation of a Split-KLOZURE is accomplished with *minimum* down-time, and *without* dismantling machines *or* removing heavy shafts, bearings, gears, couplings or other machine parts. Split-KLOZURES are ideally suited for use on machines operated in localities remote from repair or service facilities.

*For complete details on Garlock Split-*KLOZURES*, write today for bulletin AD-124.*

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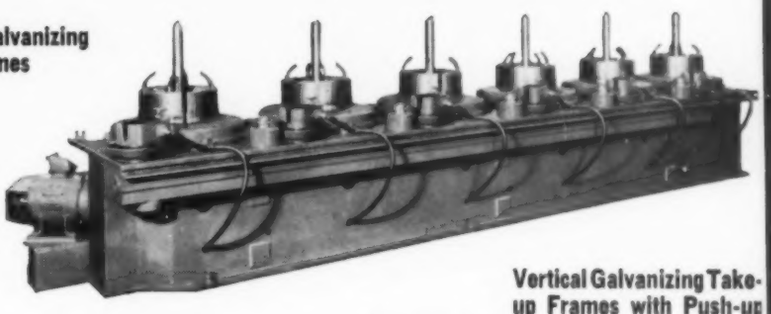
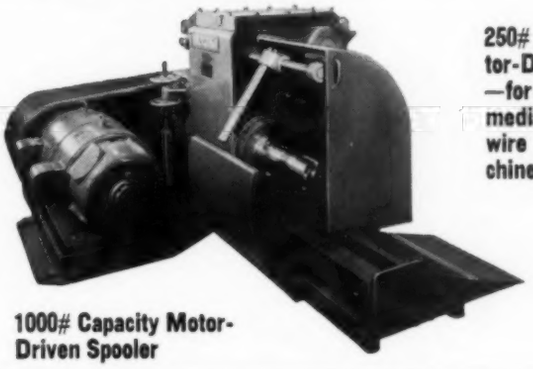


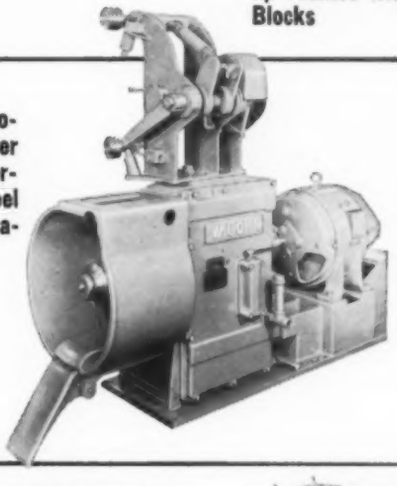
Vertical Galvanizing Take-up Frames with Push-up Blocks

SPOOLERS



1000# Capacity Motor-Driven Spooler

250# Capacity Motor-Driven Spooler —for use with intermediate or fine steel wire drawing machines



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Extra-Heavy Four-Roll Pointer for 1¼" diameter low carbon steel rod

No. 1 Continuous Pointer

Die Stringer with Pointer

No. 1 Combination Die Stringer & Power Pointer

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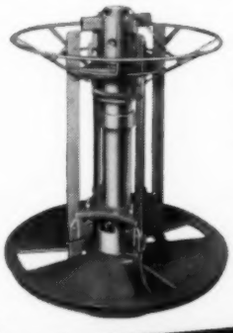
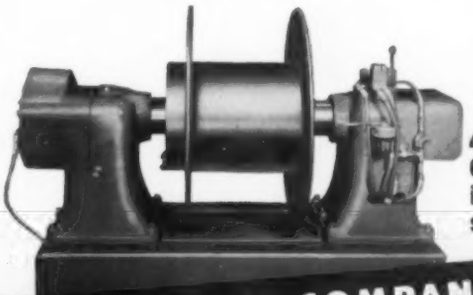


Riding Type Block Stripping Spider used with Pallet and Pay-Off Ring as a Pay-Off Reel



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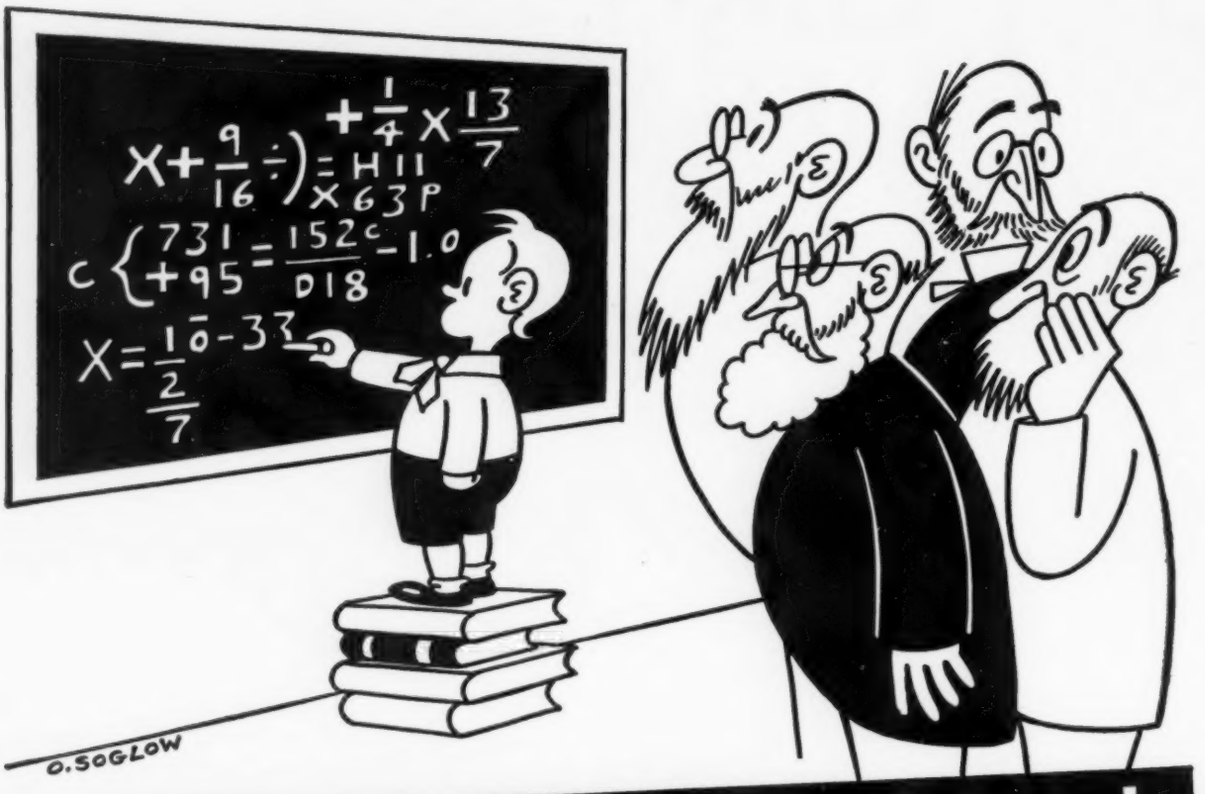

You'll be surprised at these figures!

Thanks to the thrift of employed Americans and the cooperation of 45,000 companies which have enrolled more than 8,000,000 men and women in the Payroll Savings Plan—

- Sales of E and H Bonds (H Bond is the current-income companion piece of the E Bond, sold only to individuals and purchased in larger denominations by executives) in 1954 totaled $4.9 billion, a new peacetime record.

- Sales in 1954 exceeded *all redemptions* in that year of matured E Bonds and unmatured E and H Bonds by more than $400 million—the highest net amount since 1949.

- Cash value of E and H Bonds outstanding reached a new record high of $38.2 billion, a gain of $1.5 billion in 1954.

- This $38.2 billion cash holding by individuals represents 14% of the national debt. Never before has the national debt of our country been so widely held.

These figures, far more effectively than mere words, tell the story of The Payroll Savings Plan—why it is good for America, why it is good for business. If you do not have the Plan, or if you have the Plan and your employee percentage is less than 50%, phone, wire or write to Savings Bond Division, U. S. Treasury Department, Washington, D. C.

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Every Specification Checked and Double-Checked

Few products require more careful checking than forged hardened rolls, especially those with a high finish for "touchy" kinds of work. At Bethlehem, forged rolls are not only well made by true craftsmen, but are checked with unusual thoroughness before we release them.

As a result, a customer need never have doubts about the rolls he purchases from Bethlehem. Specifications on hardness, dimensions, and finish can always be met in full, and no roll leaves our shops until they *have* been met.

This care, this attention to detail, is the basic reason for the quality of Bethlehem rolls. It applies as much to small units weighing less than 100 lb as it does to the big fellows, which often exceed 20 tons.

We'll welcome the opportunity to discuss your future needs in this field. A call from you is all that is necessary, and will of course assure the full cooperation of our engineering staff.

Recommended uses for Bethlehem forged rolls:

Cold-rolling ferrous sheets and strip
Running-down and finishing operations on copper and brass sheets
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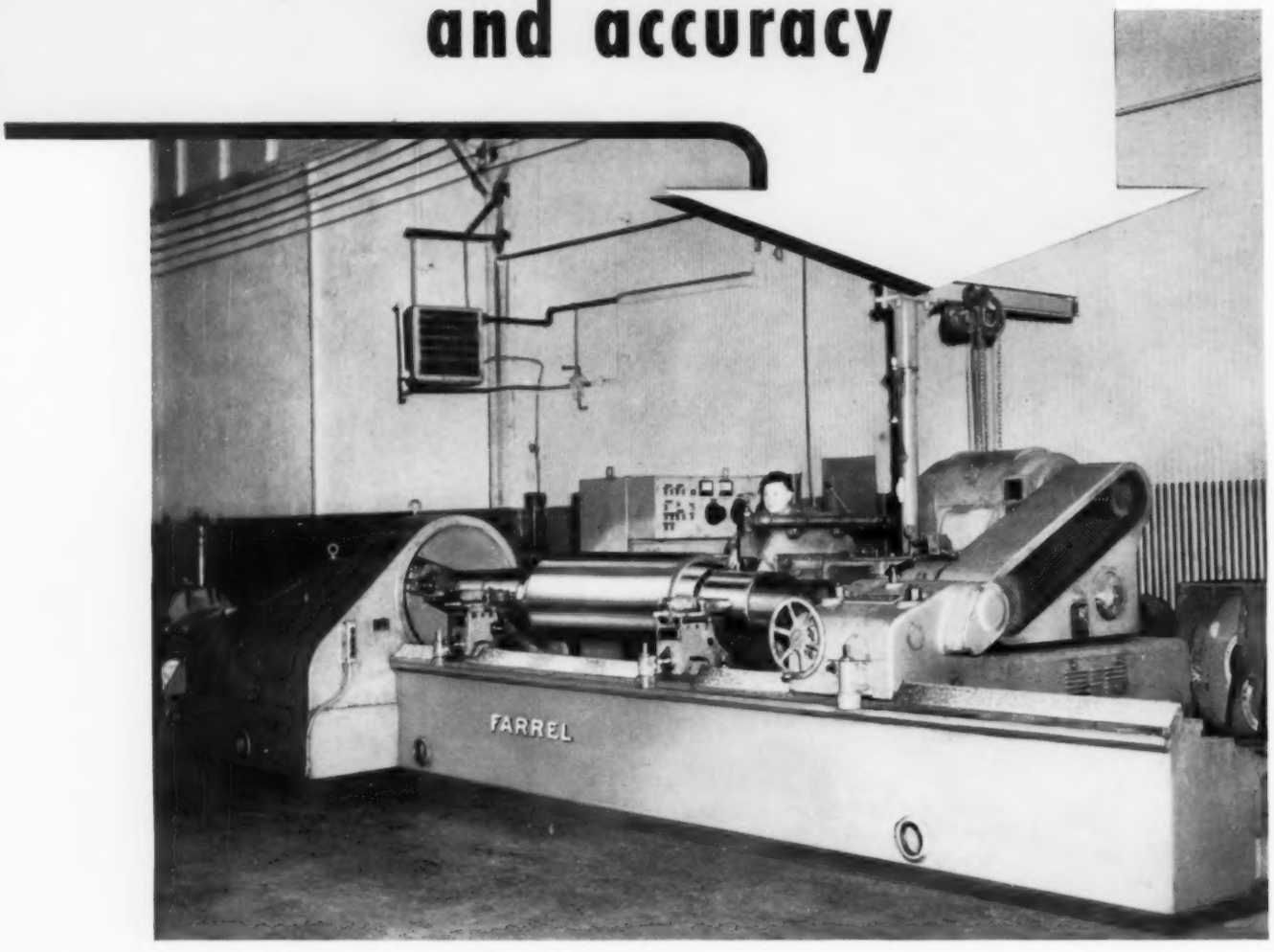
BETHLEHEM FORGED HARDENED STEEL ROLLS

How Detroit Steel gets roll grinding speed and accuracy



The 36" x 16'0 Farrel HD roll grinder above, in operation at the Portsmouth division of Detroit Steel Corporation, has shown its ability to cut roll grinding time substantially. This is true for both heavy roughing and fine finishing.

Rolls are obtained with a perfect surface, free from marks of any kind. Straight, convex or concave contours are ground to exact symmetry and accuracy.

Contributing to grinding accuracy is an automatic crowning device which grinds a mathematically accurate curve. Easily and quickly set, it requires no manipulation during operation. The same setting produces exactly the same curvature and permits fixed, uniform and easily controlled accuracy of contour in all rolls.

You, too, can step up your roll grinding speed and accuracy with a Farrel Heavy Duty machine. Available in six standard sizes. Write for descriptive bulletin.

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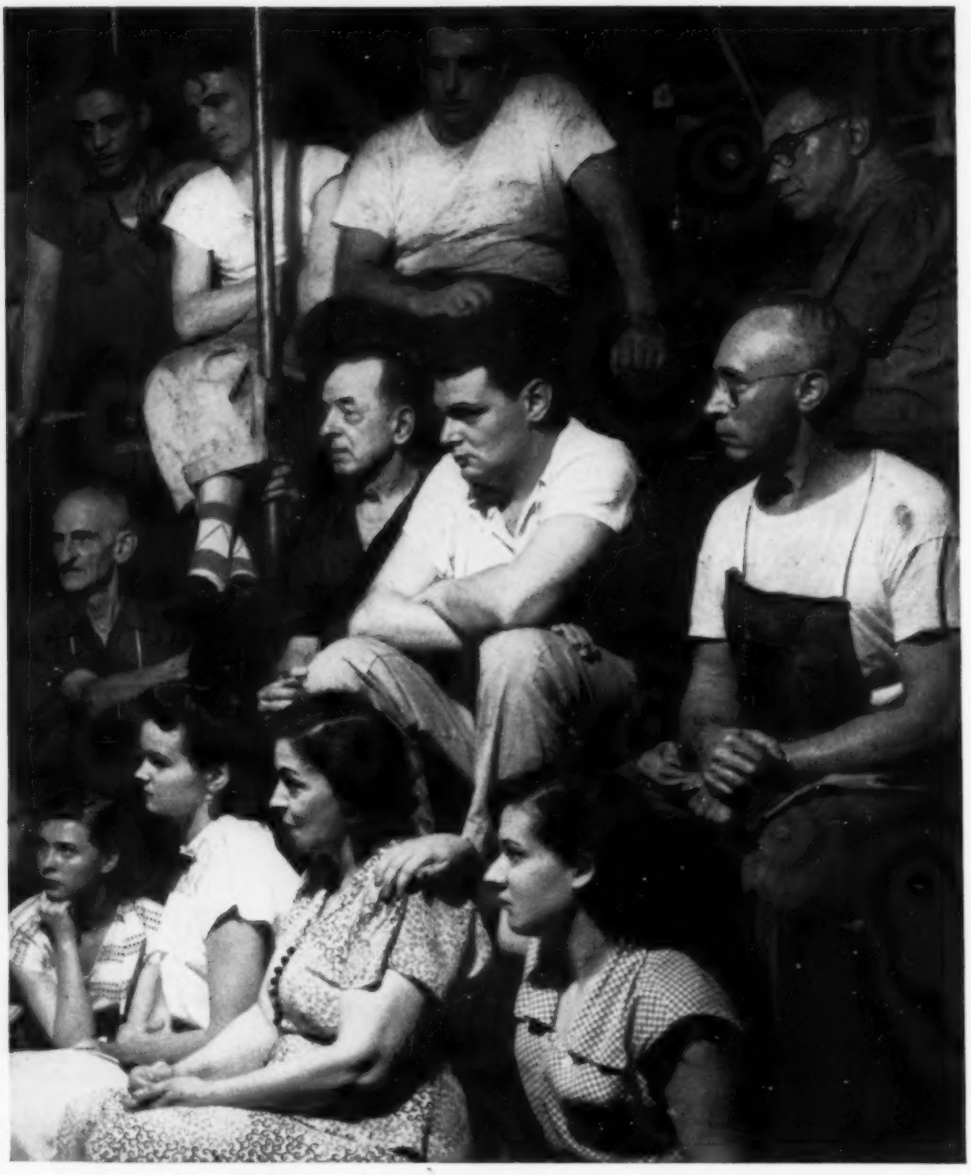

the facts of life

about cancer

The facts of death from cancer are all too familiar. Too many have known the tragedy of losing a family member... a friend... a fellow worker. Too few know the facts of life about cancer. Yet they are there for the asking... or the seeing... or the listening. The American Cancer Society teaches life-saving facts about cancer every day of the year. Through films... pamphlets... exhibits... window displays... via radio... television... newspapers... magazines... from lecturers... information centers... you can learn vital facts that might one day mean the difference between life and death.

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American Cancer Society

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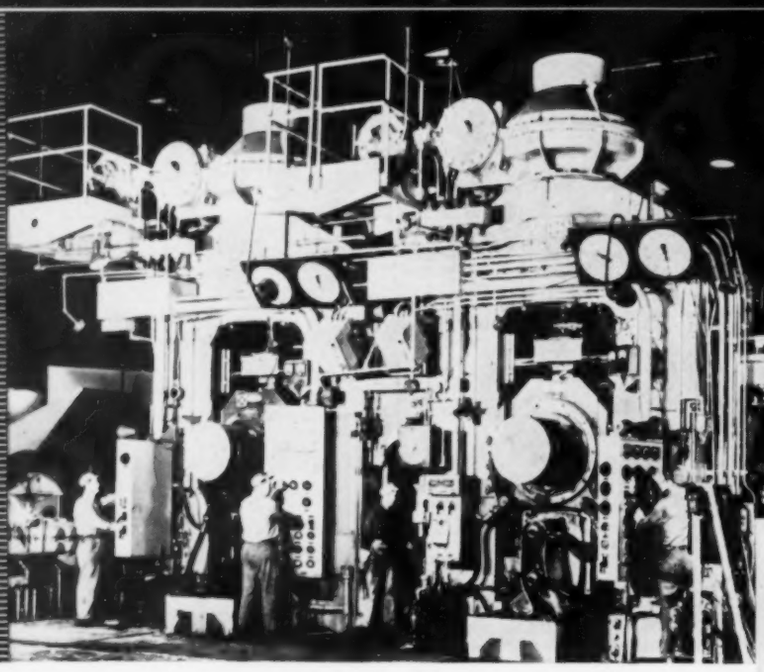

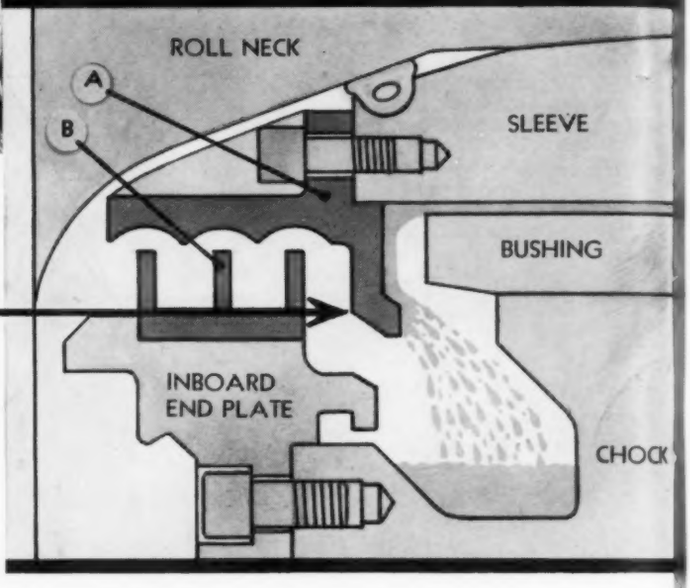

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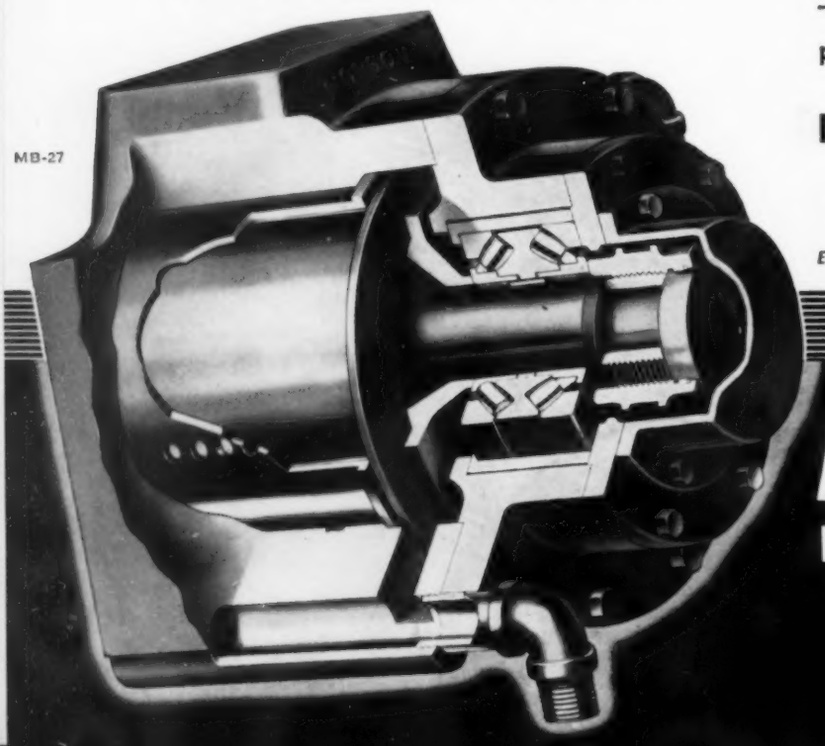

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No. 163

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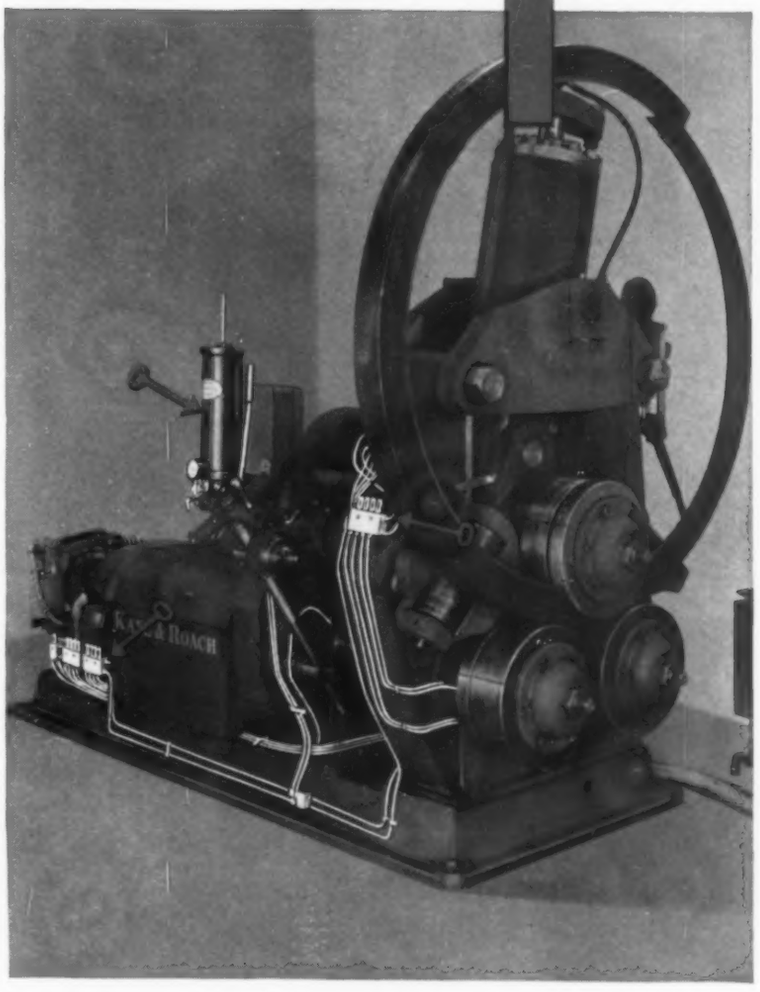

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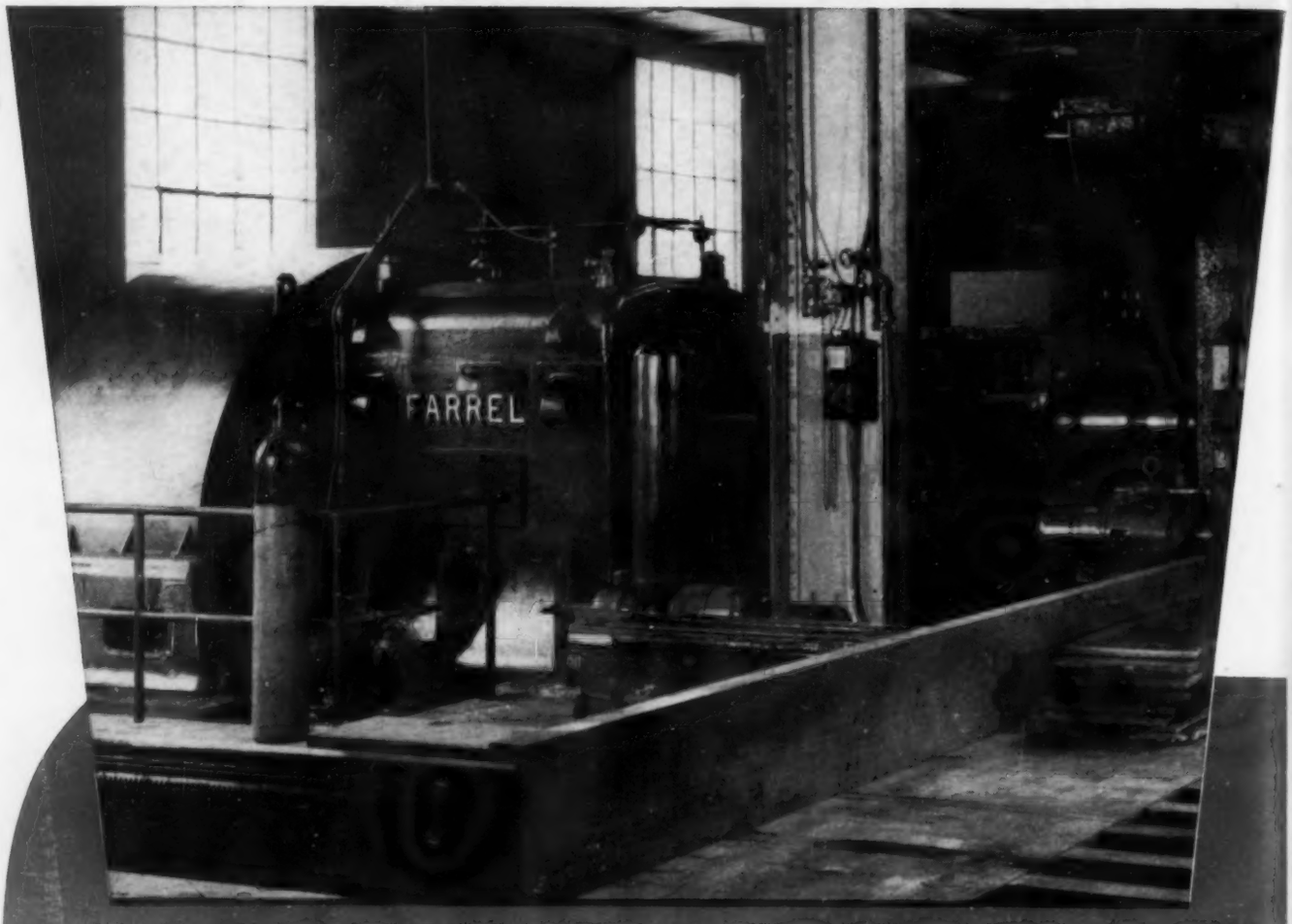

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